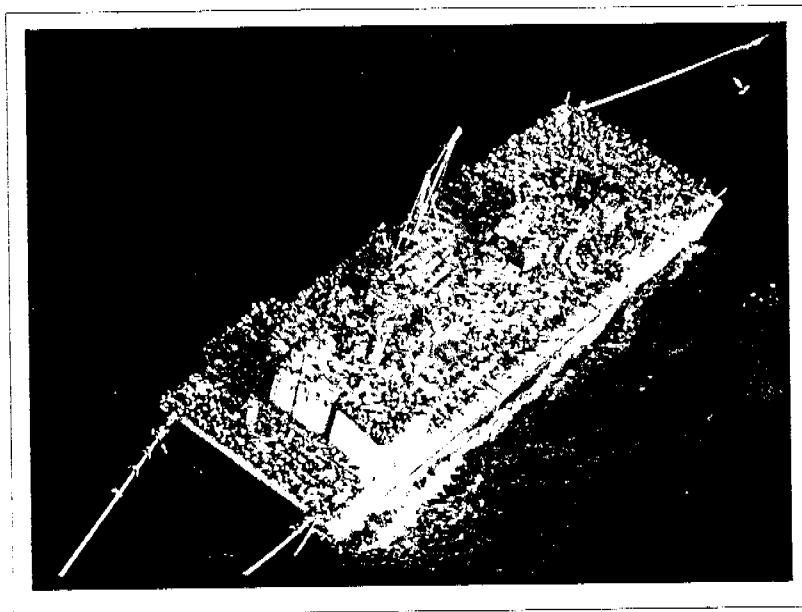


BROWN PELICAN ROOST SITES ON THE MAINLAND COAST OF SOUTHERN CALIFORNIA



Prepared for the
AMERICAN TRADER TRUSTEE COUNCIL
California Department of Fish and Game
United States Fish and Wildlife Service
National Oceanic and Atmospheric Administration

by

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9 January 2003

Cover Photo: 1,324 Brown Pelicans roosting on a barge in the outer Santa Barbara Harbor (roost SB 3.0) on June 11 1992. Photo by Deborah Jaques, Crescent Coastal Research.

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EXECUTIVE SUMMARY

Brown Pelican (*Pelecanus occidentalis californicus*) distribution along the southern California mainland coast was analyzed using aerial survey data from 1986-2000 to provide management information on use of communal roost habitat. Sixty traditional roosts were identified, of which 4 were ranked as being of “major importance” (mean count >100 birds), and 25 as “important” sites (mean > 30 birds). The breakwaters at Long Beach Harbor and Marina Del Rey provided the highest quality habitat and supported the largest roosting aggregations. Most roost habitat consisted of artificial structures, and most roosts were owned and managed by federal agencies. Roosts on private structures were subject to removal or alteration; two roosts on private structures were temporary and were eliminated during the study period, and others were in jeopardy. Gaps in the availability of quality roost habitat occurred at the north end (Santa Barbara Co. and northern Ventura Co.) and south end (San Diego County) of the study area. Recommendations for restoration and improvement of roost habitat for Brown Pelicans include creation of high quality roosts in south San Diego Bay, Batiquitos Lagoon, and the outer harbor at Santa Barbara.

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Field Observers who assisted with aerial surveys included Brad Keitt (Island Conservation & Ecology Group), Tom Keeney and Grace Smith (U.S. Navy, Point Mugu), Chris Depkin, and John Scholl. Thanks to ATTC members Carol Gorbics (USFWS Carlsbad Office), Paul Kelly (CDFG-OSPR), and Jennifer Boyce (NOAA Restoration Ctr.) for guidance and suggestions on this project, and to Carol Gorbics for review and improvements to this report. Carol Gorbics and Emilie Luciani (USFWS) provided map graphics as well. Rebecca Kramer and Anna Weinstein (National Fish & Wildlife Foundation) provided contract and accounting support.

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INTRODUCTION

The California Brown Pelican (*Pelecanus occidentalis californicus*) is a common resident and migrant of the southern California coastline and Channel Islands. The species is currently listed as federally Endangered, largely due to DDT and PCB pollution that caused widespread reproductive failure during the 1960's and early 1970's (USFWS 1983). In the U.S., nesting only occurs on Anacapa and Santa Barbara Islands in the Channel Islands National Park. Additional nesting occurs on islands along the Pacific coast of Baja California and in the Gulf of California, Mexico (USFWS 1983). In 2001, the number of nest attempts and fledglings produced by the southern California nesting population was estimated at 3180 and 2550 individuals, respectively, though the number of nest attempts and fledglings produced is variable by year (range 1486 to 5400 and 372 to 5530, respectively, during the past ten years (1992 to 2001, Gress 2002). Nesting takes place from February through June, and birds disperse throughout the Pacific coast between Mexico and British Columbia from about June through October (Anderson and Anderson 1976, Jaques 1994). Peak numbers occur along the southern California coast following the nesting season, from June through October (Anderson and Anderson 1976, Briggs *et al.* 1981, Jaques *et al.* 1996).

Throughout their range, Brown Pelicans rely on a variety of shoreline structures as roost habitat to rest and restore their plumage. Roost habitat is essential habitat for pelicans, as their plumage becomes soaked with prolonged water contact, and flying is energetically expensive (Rijke 1970, Pennycuik 1972, USFWS 1983). Roost sites are generally communal and traditional in that the birds are found in groups rather than singly, and the same sites are used consistently over years. Overnight roost sites are restricted to the most secure roosts and have a strong traditional component, thus night roosts tend to be larger and fewer than diurnal ones. Throughout much of their non-breeding range, roosts are found on offshore rocks and islands where there is protection from mammalian predators and human disturbance. On the southern California coast, natural roosting habitat for these birds is limited, and the majority of roosts are found on artificial structures (Jaques *et al.* 1996). Protection of roosting areas has become an increasingly important management issue in California, as awareness of the potential adverse impact caused by human disturbance and habitat alteration has grown. For these reasons, the protection, creation and enhancement of roost habitat was selected as an effective means of restoring injuries to Brown Pelicans caused by the *American Trader* oil spill of 1990 (American Trader Trustee Council 2001). The American Trader Restoration Plan details how creation, enhancement, and protection of Brown Pelican roost sites will benefit Brown Pelicans along the southern California coast.

This report provides a summary of the current status of roost sites in southern California with information on recent changes (since 1986), and a comparison of pelican abundance in southern California relative to the rest of the state. The report is intended to provide information to aid in the selection of restoration projects and as a baseline for quantifying the success of implemented restoration projects. We include descriptions of all regularly used roost sites, assessments of roost quality, and identification of regional gaps in suitable roost habitat.

METHODS

Data Collection

In 1986 and 1987 and again in 1992 and 1993, we conducted a series of air surveys of pelicans throughout southern California. These data were reported in Jaques and Anderson (1987), Jaques (1994) and Jaques *et al.* (1996), and are summarized in this report. From 1998 to 2000 additional fall air surveys were conducted. We carried out fall aerial surveys in 1998 and 1999 as a part of the present study (source data in Appendix. B). Aerial photographic surveys in 2000 were conducted by the U.S. Geologic Survey and Humboldt State University, with support from the U.S. Geologic Survey, U.S. Navy (Naval Air Station Point Mugu), and CDFG Office of Oil Spill Prevention and Response. Aerial surveys were also completed for central and northern California in the 1998-2000 period using the same methods.

Aerial survey flights were conducted in California DFG aircraft from 1986 to 1987 and 1998 to 2000, and in Aspen Air Services aircraft in 1992 and 1993. Most surveys were conducted during fall, when peak pelican populations in California usually occur, with additional surveys conducted in June and December. In total, 15 air surveys were conducted from the Mexican Border to Point Conception, though fog and airspace restrictions limited the coverage on some surveys (Table 1 and Figure 1). Point Conception itself was included in the central California total, as it was considered more representative of that region. Along with the pilot, two observers were aboard during most surveys: the primary roost photographer and an overview photographer/data recorder who also tallied actively foraging pelicans on the seaward side of the plane.

The survey plane flew at approximately 500 ft above sea level immediately offshore from the shoreline or roost habitat. All large roost sites were photographed with a 35 mm camera and 200-300 mm lens out an open window at an oblique angle. Pelicans were later counted individually from projected transparencies. Numbers of pelicans at small roosts (generally <20 birds) and active birds (flying or feeding) within about 1 km of shore were tallied during the flight. Roost habitat was categorized into 11 habitat types based on physical habitat characteristics (Table 2).

Ground surveys of selected roost sites were made in September 1999 and in July and September of 2000 primarily for the purpose of studying night roost status and disturbance effects. Description of methods and results are contained in separate reports (Strong and Jaques 2002, Jaques and Strong 2002), but some counts based on ground surveys are mentioned here.

Analysis

All aerial roost counts from June through November were used for evaluating sites as roosts and calculating mean use and frequency of use. December numbers were so low on the mainland coast that those data were not considered representative of roost site use. We considered a location a roost site if three or more pelicans were present on more than one visit. Areas where roosting birds were present with some consistency but at variable adjacent locations with similar

habitat were combined into a single roost “site.” This occurred within harbors, along the rocky shores of Laguna Beach and Palos Verdes, and along the beaches of northern Ventura and northern Santa Barbara Counties. Habitat type of the roost site was also simplified to name the most commonly used or important roost substrate. For example, at Palos Verdes, where pelicans roosted both on the shore and on small offshore rocks, the habitat was categorized as “offshore rocks” (OSR) because it represented the more important roost substrate.

RESULTS

We identified 60 Brown Pelican roost sites on the southern California mainland coast based on fall surveys in 1986-2000 (Tables 3a to 3e). Four roost sites that were identified in 1986 were no longer available to pelicans in the 1998-2000 surveys (noted as “historic” in the tables). Two additional small roosts in Channel Islands and Ventura harbors were noted from the ground but not in aerial surveys, and additional small roosts may have occurred within other harbors farther south. We considered a roost to be an important site if the mean number of birds present was over 30 and frequency of occurrence was over 50%. A total of 25 roosts met these criteria (Figure 1). Only 4 sites were considered major roosts, with mean counts of over 100. The largest of these were the breakwaters of Long Beach Harbor and Marina Del Rey, followed by Zuniga Point breakwater and Mugu lagoon estuary (Figure 1). Maps of roost locations are given for all important sites in Appendix B.

The major roosts (mean counts > 100 birds) described in this report are the same as found by Jaques *et al.* (1996) using the 1992-93 data alone, with the exclusion of the Santa Barbara outer harbor and Mobil Oil Pier sites, now removed and unavailable to pelicans. Most important roost sites are also in common between the two studies, though the rank order varied between the two data sets. Rank was assigned based on mean number of birds at the roost sites during our surveys.

Roost Habitat

Breakwaters were by far the most important single habitat type, supporting 42.4% of all roosting pelicans, based on an average of all surveys of the southern California coast. Jetties were a distant second, with 13.5% of roosting birds, followed by other habitat types, each holding less than 10% of the total (Figure 2a). Artificial substrate comprised 22 of the 60 roosts, but supported 66% of roosting pelicans. Offshore rocks were the most common roost type (and actually there are many more than the 13 indicated in Figure 2a, but these were grouped into single roosts if they were along similar coastline) but the rocks off southern California are small and supported just 7% of the total.

Artificial structures, Mugu Lagoon estuary and Malibu Lagoon estuary were used on more than 60% of surveys (Figure 2b). The lower frequency of use of natural habitats is largely due to their small size (offshore rocks) or higher incidence of disturbance (beaches, mainland shore, lagoon, and river mouths).

Roost Ownership and Management

The Army Corps of Engineers is in charge of maintaining most breakwaters and jetties, 48.7% of all pelicans, on average, roosted on habitat under their management (Figure 3). However, management of the structures usually involves a cooperative agreement between the U.S. Army Corps of Engineers and the respective local harbor district whose waters are protected by the jetty/breakwater structures.

Other federal entities own or manage sites where 22.7% of the pelicans roosted (for a federal total of 71.4%). The BLM recently assumed management of all offshore rocks from California Dept. of Fish and Game, thus the state portion of roost management has been reduced. An average 10.6% of all pelicans roosted on sites managed by the State of California. The most important state managed roosts are those at Bolsa Chica Wetlands State Reserve (CDFG), Santa Clara River mouth (McGrath State Park), Malibu Lagoon (Malibu Lagoon State Park), and Batiquitos Lagoon (CDFG). Just 11.5% of pelicans roosted on private structures in 1998-2000 surveys, but this figure was 23.5% when historical data (1986-1993) are included.

Loss and Alteration of Roost Habitat

Since 1986, two major roost sites have been removed, two important roosts are under threat of removal or are being removed, one important site has been degraded, and two minor roosts have been lost to pelican use. No new roost sites have been created. All site losses have been on privately owned property except one minor site (San Luis Rey river, SD 12.5).

Private barges in the outer Santa Barbara Harbor and the Mobil Oil Pier, both in Santa Barbara County, were among the largest roosts during the early 1990's. At that time, they ranked 3rd and 4th in average use for the entire southern California coast. The barges used at Santa Barbara Harbor were only available as roosts for a few years and were removed in fall 1992. The Mobil Oil Pier was removed under direction from State Lands Commission in 1996.

The following describes additional current or possible future losses of individual roost sites:

- Efforts are being made to remove the roost at Agua Hedionda (SD 12) under the direction of the city of Carlsbad, because the city is concerned that water quality and ongoing mariculture operations may be adversely affected by the roost. This may have already been accomplished as we do not have data for the 2001 season.
- There is a directive from the State Lands Commission to remove the Arco oil platform near Coal Oil Point, Santa Barbara County (Roost SB 5, 'Sandpiper Pier').
- The historic roost site at Batiquitos Lagoon was removed by CDFG in the mid 1990's. Currently the lagoon supports a minor roost on tidally exposed flats.
- A bait barge and other floating structures south of Malibu Lagoon were removed in 1993.
- A constructed island roost habitat at Luis Rey river mouth in Oceanside was eroded by winter storms in 1992 and has not been replaced.
- Roost substrate within harbors can be variable on a scale of months to years as private structures are relocated or altered.

Seasonal and inter-annual effects

The number of pelicans using a given roost site along the southern California coast varies in a somewhat regular pattern by season, and is more variable inter-annually. Anderson and Anderson (1976), Briggs *et al.* (1981), and Jaques *et al.* (1996) describe a seasonal low in pelican numbers from December to May along the southern California coast, when most birds are at nesting areas. Conversely, there is a higher abundance between June and October when pelicans move from nesting areas to mainly coastal roost sites. The majority of birds pass through southern California and on to central California, Oregon and Washington during their annual post-breeding dispersal (Jaques 1994). Distribution and local areas of concentration during summer and fall varies between years. Peaks in abundance in southern California regions occur during a pulse of migration or when prey availability is high. During these times, large numbers of pelicans can converge on an area making suitable local roost habitat a potentially limiting factor, and alternate or anomalous roost sites may be used during the day. An example of this occurred in June 1992 when over 500 pelicans were counted on Will Rogers State Beach (the beach was closed due to water pollution), and hundreds more were seen on nearby beaches in northern Los Angeles and southern Ventura Counties. Some of these sites never held over 3 birds before or since and therefore did not qualify as traditional roosts in this analysis.

During the El Nino event of 1992-93, few pelicans bred successfully in Mexico or on the Channel Islands (Gress *et al.* 1995), and numbers along the mainland shore of southern California were unusually high during both summer and winter (Figure 4). In other years, post-breeding birds may move rapidly through southern California to more northern points, resulting in very low fall survey totals. These effects cause high variability in roost counts, thus a series of surveys, such as presented in this report, are needed to provide representative information on roost site use.

Roost Habitat Distribution

Gaps in roosting habitat along the coast can increase the energy requirements for pelicans as they must access foraging areas over longer distances. Long stretches of shoreline lacking or with minimal roost habitat occur north and south from Santa Barbara Harbor (23.6 and 23.9 km, respectively), from Rincon Island to Ventura Harbor (19.3 km), between Mugu Lagoon and Malibu Lagoon (41.1 km), from Malibu Lagoon to Santa Monica 'breakwater' (17 km), and from Dana Point to Oceanside Harbor (38.1 km). Most gaps in diurnal roost habitat are in the northern half of the study area (Figure 1). The distribution of suitable night roosts is more limited than that of diurnal roosts. A summary of night roost size and distribution is contained in Strong and Jaques 2002.

State-wide Distribution

Southern California supported fewer pelicans than central or northern California on all recent fall surveys (1998-2000) having just 10-11% of the total in each year (Table 4). Central California was clearly the most important region, supporting 69 to 75 percent of the total in each year

(Table 4). Central California had more roost sites and larger roosts (118 sites, average size of 186 birds) compared with southern (60 sites, 51 birds on average) and northern (98 sites, 51 birds on average) California. Great concentrations of pelicans in the Shell Beach area, at Monterey Bay roosts, at Ano Nuevo Island, and at estuaries and offshore rocks of Marin County during the 1998-2000 period contributed to the large mean roost size in central California

Roost Quality

Quality of a roost site can best be understood in terms of (a) capacity and (b) security from disturbance and adverse environmental conditions.

Capacity: Maximum capacity can not be easily estimated other than by counts during episodes of high pelican abundance. At these times, behavioral observations show that birds are being displaced by other birds or that birds are actively searching for suitable alternate roost locations. Pelicans were concentrated in central San Diego County during the 2000 air surveys, and the Bird Rock roost (SD 9.0) was ‘overflowing’ in that pelicans were roosting on the adjacent mainland shore. From ground observations, roost sites at capacity occurred only on the artificial structures in Agua Hedionda Lagoon on 07/11/00 and 09/13/00 and at Shell Beach rocks north of Pismo Beach in central California on 09/09-10/00. At both locations all available roosting sites were occupied as dusk approached, and arriving birds were forced to land in water or continue flying. Birds were seen in the water the following dawn at both sites, and they quickly relocated onto shore at first light. Capacity is expected to be limited at times on small rock roosts (such as at Laguna Beach), during tidal inundation (such as at Zuniga Point breakwater), and on smaller man-made structures such as at the Sandpiper Pier, Agua Hedionda, or on boats and barges in harbors. Breakwaters, jetties, and beach or rocky shorelines are often of potentially unlimited capacity, but quality can be affected by disturbance or environmental effects as described below.

“Disturbance” is defined here as any event that causes pelicans to flush suddenly from their roost. Disturbance from human sources (human presence, boats, dogs, autos, aircraft) and natural sources (falcon, eagle, mammals) is the greatest identifiable source of observed roost quality degradation. Virtually all high quality roosts have a water buffer limiting or preventing human and mammalian access. On the southern California coast, roosts with a water buffer are limited to breakwaters and the small rocks at Point Loma, Laguna Beach, and Palos Verdes. With the growing number and variety of watercraft, even these island habitats may be subject to increasing levels of disturbance. A quantification and discussion of disturbance effects on southern California roost is contained in Jaques and Strong (2002).

Environmental effects are those largely due to weather and sea conditions. Examples of environmental effects on roost habitat quality are seen at the Ventura and Channel Islands Harbor breakwaters, where large swells spray or wash over much of the breakwater, eliminating roost habitat. Since large swells are most common in winter, this is typically a seasonal effect. Daily environmental effects are seen at Zuniga Point, where tidal inundation eliminates much of the roost at regular intervals. Winter storm flooding and shifting sand configurations alter roost habitat at river mouths and estuaries on a scale from years to decades. The quality of roost

habitat at Tijuana River, Malibu Lagoon, Mugu Lagoon, and Santa Clara River mouth is variable due to changing configuration of sandbars and water buffers between people and roosting areas. Exposure to wind and rain is more acute at some roosts than others, such as exposed beaches and probably on Sandpiper Pier (SB 5.0).

Site Descriptions

Brief site descriptions follow for roosts categorized as ‘important’ (mean count > 30) or that have significance in terms of restoration potential, ordered south to north. Leading each account is the site name and number (for cross-reference to Tables 3a to 3e and appendix B maps), ownership and management jurisdiction.

Tijuana River estuary, SD 1 Map 1

Owner/manager: U.S. Fish and Wildlife Service (USFWS), San Diego National Wildlife Refuge (NWR) and CDPR. CDPR property is on the south side of the river mouth, but most pelican use occurs on the NWR. The capacity and quality of this roost is variable, depending on tidal state and tidal and flood effects on sandbar configuration over the seasons. This area is also subject to frequent disturbance from ground and helicopter traffic associated with immigrants trying to get into the San Diego area and U.S. immigration officials patrolling for illegal border crossings. It is unlikely that meaningful roost habitat improvements could be achieved here due to disturbance effects and varying natural conditions at the site.

South San Diego Bay levees, SD 2.5 Map 1

Owner/manager: Western Salt Company / USFWS San Diego NWR.

Earthen levees used for salt evaporation in the south bay provide limited roosting habitat for pelicans, as well as nesting and roosting habitat for other waterbird species. The main roost site is at the southwest corner of the bay, on a peninsula formed by a defunct levee. We have not recorded high numbers here (the average was 6.5 birds from air surveys, with a peak count of 183 during ground surveys), but use appears to have increased since 1986. Pelicans were also seen at other levee structures and at the marina at Chula Vista, but use appears to be sporadic and with low numbers in general. There is considerable potential for improving the quality and quantity of roost habitat associated with or adjacent to the salt evaporation levees, and for the establishment of a night roost. The south end of the bay has extensive open water habitat with low water velocities and little watercraft activity. Restoration activity would target island habitat creation by alteration of existing levees, building islands, or installing floating structures. The lack of quality roost sites nearby, particularly of night roosts, would add further to the value of roost site improvements here. There is potential for development of a large, high quality roost habitat at this site with collaboration from the USFWS San Diego NWR.

San Diego Bay, SD 2.8 Map 1

Owner/manager: Private, U.S. Navy, Shelter Island Harbor.

Private and military structures along Silver Strand beach and at the north end of the bay support significant numbers of pelicans by day. A roost site at Crown Cove Marina was removed in the early 1990's, but another was created on a makeshift tire breakwater at Fiddler's Cove (a military

recreation harbor along Silver Strand). Shelter Cove harbor, North Island Naval Air Station, and the Coast Guard/military harbor around Ballast Point also have roost structures (barges, floating docks, pilings, buoys), but these are subject to alteration depending on activities of the military and private owners of the structures. Coverage of these sites has been incomplete during some air surveys, and description of exact location unclear, thus they were combined here. Improvements to roost habitat in these areas is not considered desirable because of private ownership, heavy recreational boat traffic, military use, and the nuisance and potential endangerment of having pelicans associated with inner harbors.

Zuniga Point, San Diego Bay mouth, SD 3.5 Map 1

Owner/manager: U.S. Navy, U.S. Army Corps of Engineers.

Breakwater rocks extending out from the jetty on the south side of San Diego Harbor entrance are the preferred roost site. Pelican use is limited by tidal height, as much of the structure is submerged at high tides. Birds also use the concrete jetty and rocks on the mainland point if the breakwater is unavailable or crowded. Human presence is restricted on the point by the North Island Naval Base, and mammalian predators have been controlled to protect Least Tern nesting habitat. Pelicans largely avoided the elevated channel marker structures towards the tip of the breakwater, and preferred the low rocks that were subject to inundation. California sea lions are common on the outer channel marker, but we have no explanation for why the other two elevated platforms were used so little. Recreational boats, shipping traffic, and frequent overflights by low altitude military aircraft are potential disturbance sources, but no disturbances were seen at this location. Restoration activities here would involve supplementing the breakwater above high water with rip-rap to create a larger and higher quality night roost.

Naval Reservation, Electronics Lab., SD 5 Map 1

Owner/manager: U.S. Navy.

Cliff ledges and a few small offshore rocks provide roost habitat for highly variable numbers of pelicans along approximately 2 km of coastline within the Naval reserve. Restricted access on the military property is likely critical to maintenance of the roost by limiting disturbance. Most birds have been seen on the mainland ledges, but both the ledges and offshore rocks are used. Night roost status is unknown.

Bird Rock, La Jolla, SD 9.0 Map 1

Owner/manager: BLM Calif. Coastal National Monument

This is the largest and farthest offshore of several small rocks around the south end of La Jolla. The flat top above reach of wave wash appears to provide a high quality roost, although it rarely supported over 20 birds. It is a suitable night roost but night use has not been checked. Capacity is limited by the rocks size; in an exceptional count during the 2000 air survey, 359 birds were listed at the rock, but over half of these were 'overflow' from the rock and roosted on the adjacent mainland.

La Jolla Caves area, SD 10 Map 1

Owner/manager: City of La Jolla.

The rocky shoreline west of La Jolla Caves is a frequently used day roost. The area is lightly fenced and has advisory signs to keep people from cliff edges. It is heavily used by people and, although pelicans have habituated to human proximity here, several disturbances were noted during a two hour observation. There is good potential for low cost restoration action here through improvement to the existing fence and more effective advisory signs.

Batiquitos Lagoon, SD 11 Map 2

Owner/manager: California Department of Fish and Game.

This lagoon lies about 7 km south of Agua Hedionda. Low numbers of pelicans consistently use the lagoon as a day roost, relying on the banks or sand islands exposed at low tide as substrate. During 1992 and 1993 surveys the lagoon was used more heavily, with a peak count of 362 pelicans occurring near the mouth of the lagoon. The area is managed by CDFG, which has invested considerable resources to stabilize the lagoon mouth and establish a Least Tern nesting area. These habitat modifications caused a loss of preferred pelican roost habitat near the mouth, and the birds now use only sandbars and mudflats farther up the lagoon. There is potential for development of large, high quality roost habitat at this site. The lagoon has a large acreage of open water of moderate depth with low recreational use and low current velocities where roost creation is possible. The persistent use by pelicans on the existing low quality habitat indicates a high potential for success if secure roosts were created. Roost site creation here would provide some mitigating compensation for the impending removal of the roost at Agua Hedionda, as well as the habitat loss described above.

Agua Hedionda Lagoon, SD 12 Map 2

Owner/manager: San Diego Gas and Electric/Carlsbad Aqua Farms.

The primary roost at this site has been on floats set out by a mariculture company for shellfish production. This lagoon has been consistently used by pelicans in all prior surveys of southern California, with an average count of 70 birds present. Night roost use is higher than day use, with an average count of over 200. During ground surveys we noted the maximum capacity the roost has varied around 250 to 380 or more depending on the configuration of mariculture structures. Disturbance from mariculture activities is persistent and occurs several times a day, but there is little other disturbance. Contact with the company revealed that they were under order from the City of Carlsbad to eliminate the roost due to concerns of excess bacteria loading of the lagoon. During summer and fall 2000, wire exclusion devices had been placed on the larger floats that pelicans used. The site was still used, but remaining floats available for roosting were round and less stable, and provided a reduced capacity and lower quality roost than existed previously. The entire roost may be (or has been) eliminated. Roost site creation or enhancement here appears to be in conflict with current management goals at Agua Hedionda.

Oceanside Harbor Jetty, SD 13 Map 2

Owner/Manager: Oceanside Harbor/ U.S. Army Corps of Engineers.

The roost site is on a long jetty with difficult human access from shore. It was used as a minor night roost in our observations; there are few alternative night roosts in the area. Disturbance sources are fishermen accessing the jetty by walking or by boat, watercraft, and low flying aircraft. Restoration action could include signs or fencing to reduce disturbance.

Dana Point Harbor jetties, OR 3 Map 3

Owner/manager: Dana Point Harbor District/ U.S. Army Corps of Engineers.

Pelicans roost on both jetties and on a bait barge in Dana Point harbor, and occasionally at San Juan Creek mouth in Doheny State Park just south of the harbor (OR 2.9). The long north jetty receives the least disturbance and is used as a night roost. Pelicans were habituated and tolerant of close watercraft at Dana point, but disturbance to small numbers of pelicans from close boat approaches were fairly common. Pelicans, herons, and gulls pose a nuisance to commercial bait barge operations within the harbor. Information was not available to assess the issue of human disturbance by fisherman using the jetty. Restoration here could involve fencing to restrict shore access to the night roost area and signs to limit watercraft approaches. This may be the largest night roost south of Long Beach Harbor with the elimination of the Agua Hedionda site. There is the potential for increase in night roost use if human access was curtailed.

Bolsa Chica Wetlands, OR 10.1, Map 4

Owner/manager: CDFG/ Bolsa Chica Conservancy.

Created island habitats near the south end of the wetlands area at Bolsa Chica provide the roost substrate. The islands have a permanent water buffer and are suitable night roost habitat, but it is not known if they are used at night. The Long Beach breakwaters provide alternate high quality roost habitat 9 km to the north. The islands were created and are managed to provide nesting habitat for endangered Least Terns. Presence of large pelican groups here has potential for disruption of tern nesting activities and may be in conflict with existing management objectives.

Anaheim Bay jetties OR 11 Map 4

Owner/manager: U.S. Army Corps of Engineers/ USFWS Seal Beach NWR.

The jetties on either side of Anaheim Bay, at the entrance to Seal Beach NWR, support a large day roost for pelicans. Night roost status has not been determined. The longer southern jetty is the main roost, and often the only one with pelicans on it. Fishermen access both jetties with an unknown frequency, and cause disturbance when they do. Pelicans sometimes forage within the wetlands of Seal Beach NWR, but there is little roost habitat available there. Protecting the jetty roost habitat from fisherman access would improve the quality of the site, and creation or improvement of roost habitat within Seal Beach NWR would provide an alternate site adjacent to an estuarine foraging area.

Long Beach Harbor breakwaters, LA 1 and 2 Map 5

Owner/manager: Long Beach Harbor /U.S. Army Corps of Engineers.

The combined eastern and central breakwaters protecting the outer harbor at Long Beach are the largest roost site on the southern California coast, and probably the highest quality. The combined breakwaters extend for 9.4 km in length, are broad and somewhat protected from winter surf, providing virtually unlimited capacity. It is expected that night roost numbers would be higher than during the day, but observations were not possible from shore. Potential disturbances to this roost are from recreational fishermen and boaters, but disturbance data is lacking. The distance to shore and heavy shipping traffic in the harbor may reduce disturbance from recreational boats relative to smaller harbors. If boats access one part of the breakwater, alternate sites are found elsewhere on the structures, since they are so large.

San Pedro Jetty, LA 3 Map 5

Owner/manager: Long Beach Harbor /U.S. Army Corps of Engineers.

The jetty extending 1.6 km out from the north side of Long Beach Harbor provides a day roost for pelicans. The jetty surface is relatively flat and easily accessed by people, but is still used by significant numbers of pelicans. No restoration action is considered suitable here.

King Harbor jetties, LA 11 Map 5

Owner/manager: King Harbor District/U.S. Army Corps of Engineers.

Both jetties and floating structures (bait barge, other barges, buoys) provide roost substrate. The 1 km long outer jetty was used as a night roost by small numbers of birds, as were buoys in the harbor. Fishermen on the jetty at night disrupted the night roost during our observations, demonstrating the limitation of the habitat and the potential for improvement. Disturbance from shore, water, and air were seen at this roost. Restoration activities (fencing and signs) could limit shore and watercraft disturbance and would enhance night roost quality.

Marina Del Rey breakwater, LA 12 Map 6

Owner/manager: Marina Del Rey/U.S. Army Corps of Engineers.

This breakwater is 0.8 km long and provides a major day roost, comparable with that of the Long Beach breakwaters. Night roost use tends to be even higher. Winter surf could reach the top of the breakwater, but this was not recorded in our observations. The site is subject to a host of watercraft using the harbor, including rafts, kayaks, jet skis, powerboats, and sailboats, as well as aircraft overflights. Pelicans were tolerant of all but the closest approaches during our observations. Restoration activities here would include placement of signs to keep watercraft from approaching too closely.

Malibu Lagoon, LA 16 Map 6

Owner/manager: California Department of Parks and Recreation.

Pelicans roost on ephemeral islands within the lagoon, in shallow water, on the beach berm between the lagoon and ocean and an intertidal gravel bar near the surf zone. The gravel shoreline of the lagoon is flooded and reduces roost substrate during periods when the mouth is closed, which happens at irregular intervals. Despite frequent disturbance by park visitors, this was a fairly heavily used site; alternative sites are over 25 km away (Marina Del Rey).

Restoration action here could include advisory signs to keep people and dogs from entering areas close to the lagoon edge where pelicans typically roost. Reduced human presence in the estuary would also benefit roosting Snowy Plovers, Least Terns, and a host of wetland bird species.

Mugu Lagoon estuary, VN 4 Map 7

Owner/manager: U.S. Navy.

The major roost at Mugu Lagoon estuary ranks 4th largest on the coast. Due to naval reservation access restrictions and proximity to the breeding and roosting sites on Anacapa Island, Mugu Lagoon is one of two estuaries in southern California to support a consistent, large pelican roost, and the only estuary to have a relatively consistent night roost. The roost was intensively studied in 1992 and 1993 and readers are referred to that report (Jaques *et al.* 1996) for further detail. Currently another intensive research effort is underway at the site (Capitolo *et al.* 2002). The roost habitat is dynamic in nature, since winter storms and floods alter the configuration of islets and sandbars at the mouth, where the pelicans concentrate. The U.S. Navy Point Mugu Naval Air Weapons Station is involved in management and preservation of the roost site (Jaques *et al.* 1996, USFWS 2001).

Santa Clara River estuary, VN 7 Map 8

Owner/manager: California Department of Parks and Recreation, McGrath State Beach unit.

The physical structure of this estuary is quite dynamic, being altered by winter flooding, tidal effects, and temporary formation of lagoons when the beach berm seals off the river mouth from the ocean. It is a consistently used day roost with widely fluctuating numbers, but is not used at night. An exceptional peak count of 1540 birds was recorded from the ground in September 1988. The changing physical structure results in variable exposure to disturbance and predators. Persistent use of this site even when roost habitat appears marginal illustrates the site fidelity behavior involved in maintaining roost sites. Restoration actions here would consist of permanent signs at beach access locations and portable signs restricting access to the sensitive areas of the estuary when used by pelicans. Protection of pelican roost habitat would also benefit Snowy Plover and Least Tern nesting and roosting areas.

Ventura Harbor, VN 8 Map 8

Owner/manager: Harbor district /U.S. Army Corps of Engineers.

The Ventura Harbor breakwater is 0.75 km long and is constructed with a small angle and a 'spur' jutting out on the landward side. The spur provides the most wave protected area, and small numbers of birds stayed there overnight in 1999, but not in 1992 or 1993. Large waves wash over the breakwater, limiting roost habitat at times, particularly in winter. Channel Islands Harbor breakwater, 11 km to the south, is lower and more exposed to wave wash and had correspondingly fewer birds roosting on average. The proximity to Mugu Lagoon and Anacapa Island allows the birds to find alternate sites if the breakwaters are unsuitable. The interior of Ventura harbor supported up to 30 pelicans on various structures. The breakwater roost was subject to disturbance from a variety of watercraft and fishermen, but the birds appeared habituated to all but the closest approaches. Restoration at this site would consist of adding material to the breakwater to provide protection from winter storm surf, such that it could serve as a secure night roost. Another action would be to install advisory buoys or signs to reduce

watercraft disturbance and landing on the structure. Considering the proximity of alternate sites, this may have limited benefit.

Mobil Oil pier and Rincon Island, VN 10 and 11 Map 8

Owner/manager: Windsor Energy Corporation.

These privately owned artificial structures had become important roost sites in the eastern Santa Barbara Channel. The oil pier was a very important site in the early 1990's, ranking third behind the large breakwaters, but it was removed by 1997. The Rincon Island site, 1.5 km north of the previous oil pier, has roost habitat around the perimeter where the island is protected from the seas by huge concrete 'dolo' forms that provide the roost substrate. . Our mean count at Rincon Island from 1986-1999 was 97 pelicans, making it the 6th largest roost in southern California in this analysis. Use of Rincon Island has increased since removal of the Mobil pier in 1997. Capitolo *et al.* (2002) had a mean of 644 birds at Rincon Island in 2001. The current relative importance of this site would be better assessed by using data collected after 1997. Industrial activities and human disturbance may negatively impact use of the site. Restoration options would include actions to limit human access to the primary roosting areas. A conservation easement on the south and west sides of the island perimeter has been discussed, as well as installation of visual barriers between an existing ocean viewing deck and the outer seawall roosting area.

Outer Santa Barbara Harbor, SB 3 Map 9

Owner/manager: Santa Barbara Harbor District.

Pelican numbers in the Santa Barbara area were very low during the 1998 to 2000 period, during both aerial and ground based surveys. In the early 1990's, pelicans used two out-of-service mariculture barges in the outer harbor consistently as a day and night roost, with a peak count of 1,480 birds, when the barge was near its capacity as a roost (Jaques *et al.* 1996). There have been no comparable structures available since these barges were removed in fall 1992. Restoration activities here would consist of roost site creation in the outer harbor in the form of a floating structure (such as a retired barge, military vessel or fishing boat). Considering the gap in roost availability along the Santa Barbara coastline and proven high use of the previous site, roost site creation here would be expected to have the greatest benefit to pelicans among all restoration options considered.

Santa Barbara Harbor, SB 4.0 Map 9

Owner/manager: Santa Barbara Harbor Dist./private.

Pelicans roost on a variety of structures in the harbor area, most consistently on the Wharf roof tops, dredge barge, and buoys. A dredge barge was the largest roost area in 1998-1999 and provided night roost habitat, although temporary. Pelicans scavenged at the wharf and live bait storage areas and negative interactions with people were observed. Use of the inner harbor appears to have increased in recent years; the mean count during the 1986-1993 period was 11.7 where in 1998-2000 it was 87.2. Creation of higher quality habitat in the outer harbor may cause a reduction in use of the inner harbor.

Sandpiper Pier, Coal Oil Point, SB 5 Map 10

Owner/manager: Arco Oil / State Lands Commission.

This artificial island on a defunct oil production platform about 700 m from shore provides a secure roost and consistently supports Brown Pelicans. Pelican use is limited by space, some of which is occupied by Brandt's Cormorants that nest on the platform from April to August. It is a suitable night roost, though we have not documented use at night. With the loss of the privately owned roost sites in Santa Barbara, this remains the only significant secure roost site in Santa Barbara county. The platform is in jeopardy of removal by the owners (Arco) at request of the California State Lands Commission. Restoration at this site would consist of preventing its destruction and increasing roost surface area and stability. If the platform is removed, it is recommended that mitigation for loss of this high quality roost site be pursued and roost site creation be enacted at another location.

Northern Santa Barbara County beaches, SB 8 and 9 maps 10 and 11

Owner/manager: Santa Barbara County and California Department of Parks and Recreation (8) and the Hollister Ranch (9).

Limited human access and a lack of offshore roost habitat are probably the main factors making this area an important roost site for pelicans. Birds were consistently present at the south end of El Capitan State Beach, near Gaviota, and near Government Point just south of Point Conception, and sporadically present at many other locations. Although we did not survey these areas at dark, it is highly unlikely that the beaches are used as a night roost. The nearest alternate day and night roost sites are on the Channel Islands, about 45 km away.

MANAGEMENT RECOMMENDATIONS

This study suggests that the greatest need for enhancement or creation of roost habitat along the southern California mainland lies in Santa Barbara and San Diego counties, due to lack of major roost sites in those areas. All of the existing highest quality roost sites are located in the central portion of the coastline. Enhancements should provide long-term stability of roost sites and management oversight by resource agencies. Education is needed both of the public and the site managers to ensure that current roost sites and potential future roost sites are adequately maintained and protected. We recommend that restoration efforts be developed that first enhance night roost sites since these are most critical. Specific recommendations on night roost restoration opportunities can be found in Strong and Jaques (2002).

The following summarizes recommendations for enhancement of diurnal roost sites and identifies those areas where such enhancement would also benefit night roost sites.

High Priority (south to north)

- Expansion of day and night roost availability in San Diego NWR through modifications of levees associated with salt ponds or installation of floating structures.
- Development of a high quality day and night roost habitat at Batiquitos Lagoon with collaboration from the CDFG.

- Considering the gap in roost availability along the Santa Barbara coastline and proven high use of the outer Santa Barbara Harbor sites lost in the early 1990s, roost site creation here would be expected to have the greatest benefit to pelicans among all restoration options considered for both day and night roost habitat.

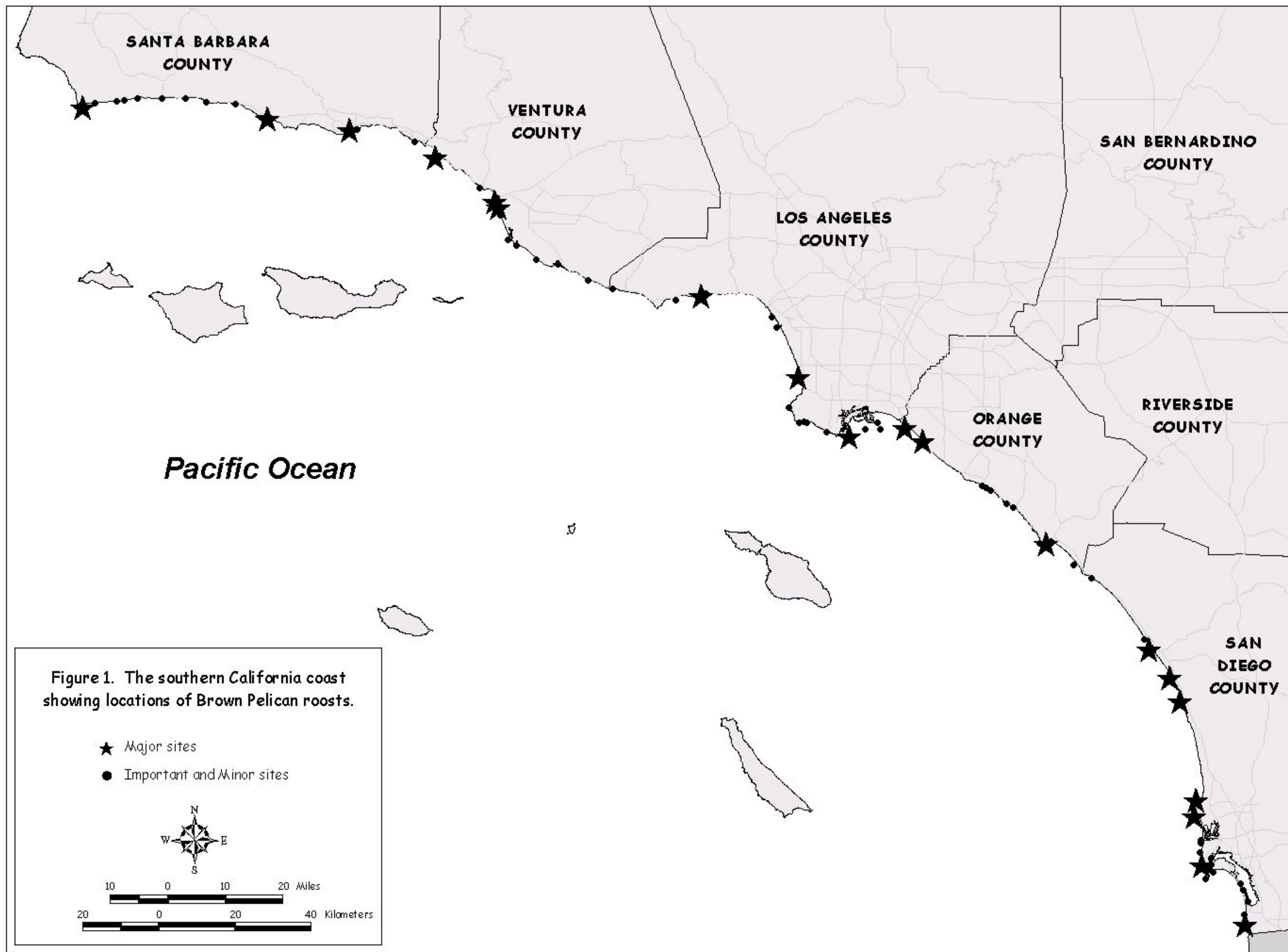
Moderate Priority (south to north)

- La Jolla Caves fencing and signs could be improved to provide better day roost habitat.
- Restoration at Dana Point Harbor jetties would involve fencing to restrict shore access to the night roost area and signs to limit watercraft approaches. There is the potential for significant increase in night roost use if human access were eliminated.
- Restoration activities at King Harbor Jetties (fencing and signs) could limit shore and watercraft disturbance and would enhance night roost quality.
- Marina Del Rey breakwater restoration activities would include placement of signs to keep watercraft from approaching too closely which would enhance day and night roosts.
- Restoration actions at Malibu Lagoon and Santa Clara River would involve advisory signs to keep people and dogs from entering areas close to the lagoon edge where pelicans typically roost during the day and night. Reduced human presence in the estuary would also benefit roosting Snowy Plovers, Least Terns, and a host of wetland bird species. California Dept. of Parks and Recreation is the resource management entity for both areas.
- Securing some management control over the fate of the Sandpiper Pier oil platform to prevent its destruction would provide significant benefit to pelicans and nesting Brandt's Cormorants. Alternatively, requiring the owner/managers of the platform to recognize the value of resources associated with the structure under the ESA and Migratory Bird Treaty Act would aid in obtaining mitigation if the structure is removed.

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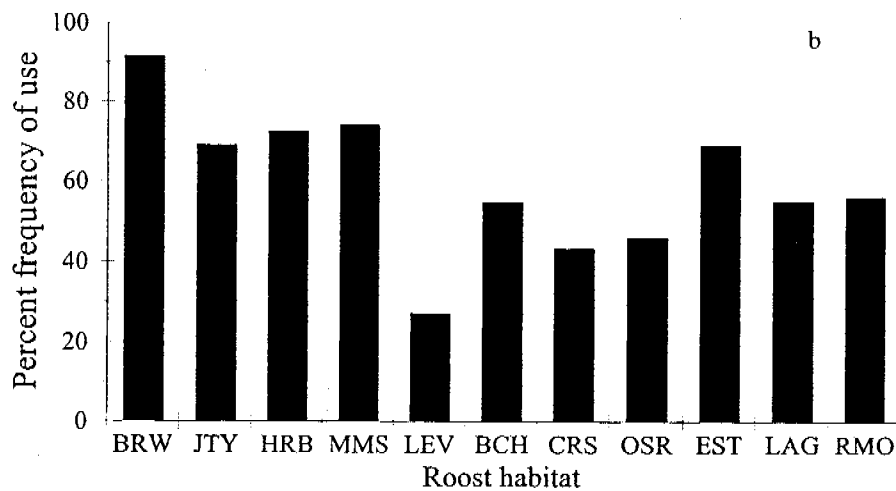
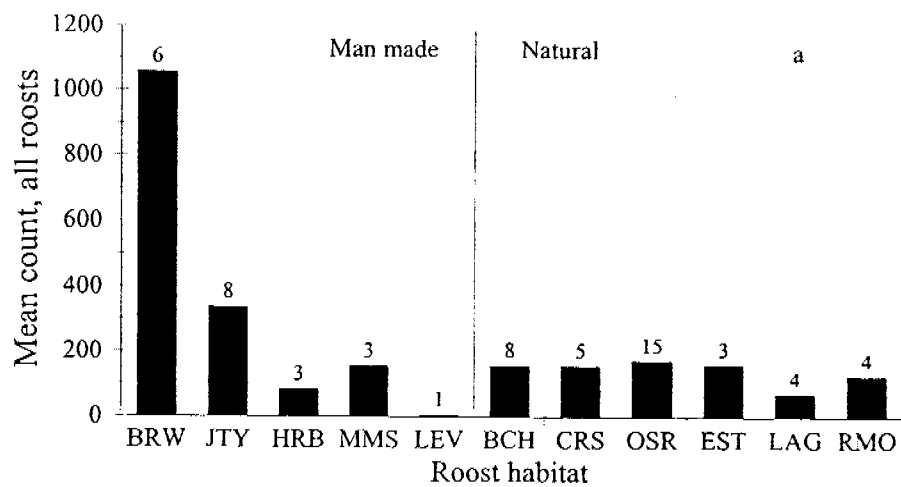


Figure 2 a and b. Brown Pelican roost habitat on the southern California mainland. Top (a) shows the number of birds using each habitat type from a mean of all aerial surveys, with the number of roosts of each habitat type at top of bars. Bottom (b) shows the mean frequency with which pelicans used all roosts in each habitat type. See Table 2 for habitat category descriptions.

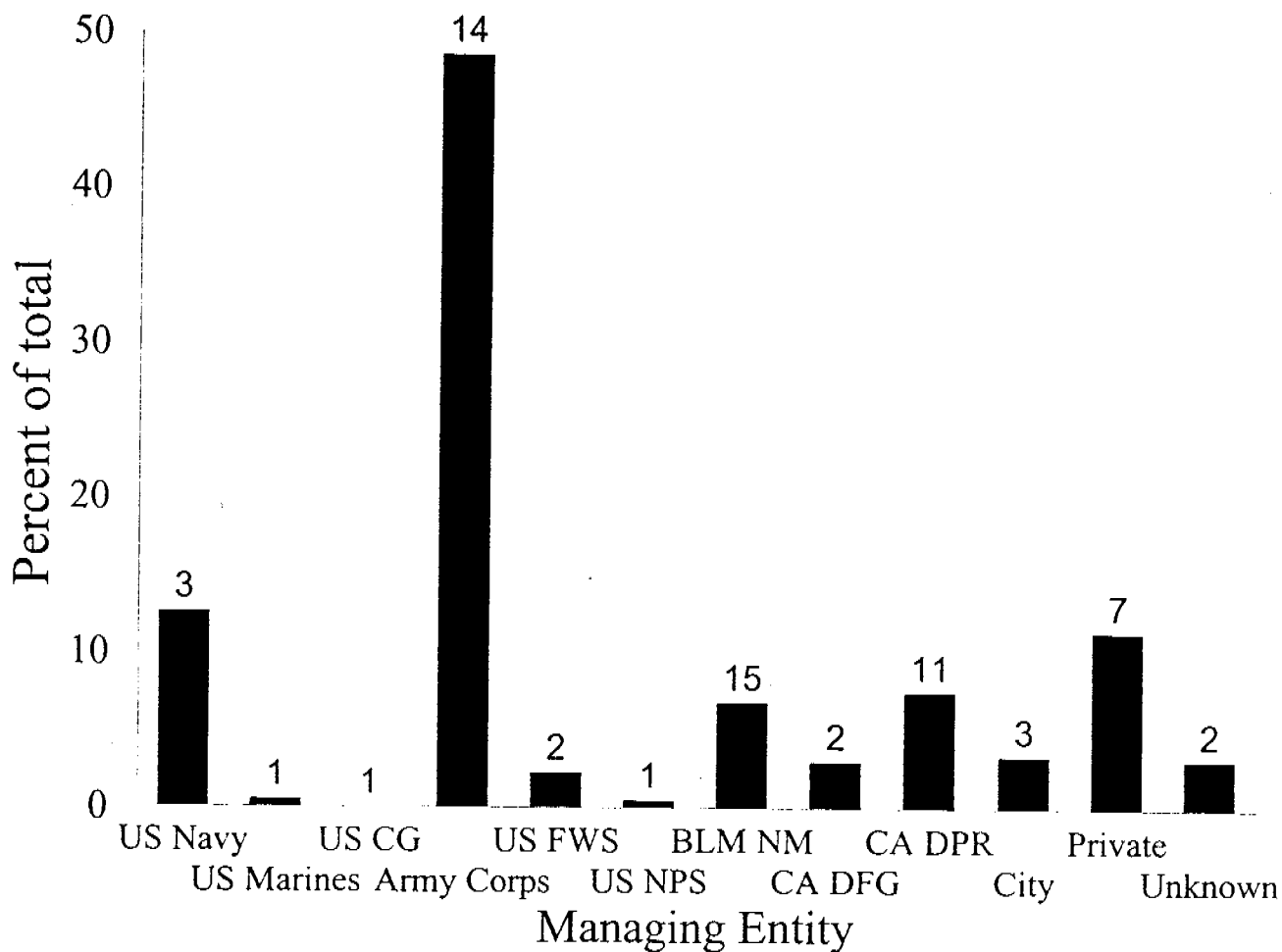


Figure 3. Percent of Brown Pelican roost use by managing entity. Percent is based on the mean number of pelicans under each managing entity on all aerial surveys of southern California, 1986 to 2000 (excluding historic sites). Numbers at top of bars are the number of roosts (ownership divisions in roosts SD 2.8 and SD 15 result in 62 roosts). Agency acronyms are:

US CG - United States Coast Guard
 Army Corps - U.S. Army Corps of Engineers
 US FWS - United States Fish & Wildlife Service
 US NPS - United States National Park Service
 BLM NM - Bureau of Land Management, California Islands National Monument
 CA DFG - California Dept. of Fish & Game
 CA DPR - California Dept. of Parks and Recreation

Table 1. Summary of Brown Pelican aerial survey effort along the southern California mainland coast from 1986 to 2000.

DATE	AREA SURVEYED	NOTES
28 August 1986	Tijuana R. to Pt. Conception	Fog obscured portions of coast
15 September 1986	Tijuana R. to Pt. Conception	LA harbor surveyed twice
16 September 1986	LA Harbor	
31 October 1986	Tijuana R. to LA Harbor	
1 December 1986	Tijuana R. to Pt. Conception	
21 July 1987	Tijuana R. to Pt. Conception	except Marina Del Rey (air traffic)
13 October 1987	Tijuana R. to Gaviota	
8 December 1987	Tijuana R. to Pt. Conception	
11 June 1992	Tijuana R. to Pt. Conception	
19 August 1992	Tijuana R. to Pt. Conception	
24 September 1992	Tijuana R. to Pt. Conception	
10 November 1992	Tijuana R. to Pt. Conception	
10 June 1993	Tijuana R. to Pt. Conception	
28 September 1993	Tijuana R. to Pt. Conception	
25 September 1998	Tijuana R. to Pt. Conception	except Marina Del Rey (air traffic)
25 August 1999	Tijuana R. to Oxnard	
26 August 1999	Oxnard to Pt. Conception	
11 September 2000	Tijuana R. to Orange Co. Line	
12 September 2000	S. Orange Co. to Pt. Conception	

Table 2. Habitat Types used by California Brown Pelicans in southern California.

Code	Habitat Description*
OSR	Offshore rock or island, open coast
CRS	Mainland shore of open coast, cliff or rocky shoreline
BCH	Mainland shore open coast, beach sand or with cobble structure
RMO	River or creek mouth, whether flowing to sea or not
EST	Estuary, river mouth with estuarine habitat or continuous exchange with the sea
LAG	Lagoon, a large water body having some deeper water (over 8 ft), with intermittent or continuous exchange with the sea
HRB	Harbor and structures within harbors (barges, pilings, boats, buoys, etc.)
BRW	Breakwater, a detached portion of harbor rip-rap protection
JTY	Jetty, rip-rap harbor protection attached to shore (accessible on foot)
MMS	Other Man-made structures (oil platforms, offshore barges and buoys)
LEV	Levee (the only levee structure was in San Diego Bay)

*The distinction between Estuary, lagoon, and river mouth habitats is difficult in southern California, since freshwater flow is generally seasonal, and physical connection to the sea may be intermittent.

Table 3a. Diurnal roost site summary on the Southern California mainland coast from fall air surveys 1986-87, 1992-93 and 1998-2000: San Diego County. Rank is the order of the mean count of all roosts. See Table 2 for Habitat Type codes.

ID loc.	Location		Abundance				Characteristics	
	Roost site name	Mean count	Rank	Range	% use	no. obs	Habitat Type	Km to night roost
SD 1	Tijuana River	52.5	13	0 - 350	53.9	14	EST	17
SD 2.5	South San Diego Bay	5.9	49	0 - 26	30.0	11	LEV	12
SD 2.8	San Diego Bay harbors	29.5	26	0 - 130	70.0	11	HRB	3-8
SD 3.5	Zuniga Point	158.2	3	0 - 700	92.3	13	BRW	0
SD 4	Point Loma shoreline	12.5	37	0 - 50	38.5	13	CRS	8
SD 5	Naval Res. Electronics Lab.	32.8	22	0 - 247	38.5	14	CRS	9
SD 6	Azure Vista rocks	21.1	30	0 - 162	23.1	14	OSR	13
SD 7	Ocean Beach pier	5.8	51	0 - 47	46.2	14	MMS	15
SD 8	Mission Bay	13.1	35	0 - 110	38.5	14	JTY	16
SD 9	Bird Rock, La Jolla	32.6	23	0 - 359	76.9	14	OSR	21
SD 9.9	Point La Jolla	18.8	32	0 - 81	33.3	13	CRS	23
SD 10	La Jolla Caves	35.9	18	0 - 239	38.5	14	CRS	26
SD 11	Batiquitos Lagoon	43.7	15	0 - 362	41.7	12	HRB	7
SD 12	Agua Hedionda Lagoon	36.7	17	0 - 116	91.7	12	LAG	0
SD 12.5	San Luis Rey River (historic)	4.7	-	0 - 26	41.5	12	RMO	3
SD 13	Oceanside Harbor jetty	52.4	14	0 - 284	75.0	13	JTY	0
SD 14	Santa Margarita River mouth	12.4	38	0 - 99	41.5	13	RMO	2.5
SD 15	Camp Pendleton & San Onofre	3.9	55	0 - 29	33.3	14	BCH	12

Table 3b. Diurnal roost site summary on the Southern California mainland coast from fall air surveys 1986-87, 1992-93 and 1998-2000: Orange County. Rank is the order of the mean count of all roosts. See Table 2 for Habitat Type codes.

Location		Abundance					Characteristics	
ID loc.	Roost site name	Mean count	Rank	Range	% use	no. obs	Habitat Type	Km to night roost
OR 2	San Mateo Rocks	7.2	47	0 - 75	38.5	13	OSR	10
OR 2.9	Doheney SB	2.0	57	0 - 5	60.0	5	RMO	1
OR 3	Dana Point Harbor jetties	98.4	5	6 - 341	100	13	JTY	0
OR 4	Dana Point, San Juan rocks	5.8	52	0 - 43	58.3	13	OSR	1
OR 7.5	Laguna Beach rocks	20.7	31	0 - 133	84.6	14	OSR	13.5
OR 8.5	Laguna Beach, Emerald Bay	5.1	54	0 - 51	50.0	14	OSR	15
OR 9.0	Crystal Cove/Pelican Point	7.8	44	0 - 41	38.5	13	OSR	19.5
OR 9.1	Arch Rock, Corona Del Mar	2.2	56	0 - 17	23.1	13	OSR	21
OR 9.2	Newport Bay jetty	7.3	46	0 - 45	40.0	10	JTY	22.5
OR 10.1	Bolsa Chica Wetlands	33.5	21	0 - 265	50.0	14	LAG	9
OR 11	Anaheim Bay jetties	68.1	9	0 - 250	92.9	14	JTY	4

Table 3c. Diurnal roost site summary on the Southern California mainland coast from fall air surveys 1986-87, 1992-93 and 1998-2000: Los Angeles County. Rank is the order of the mean count of all roosts. See Table 2 for Habitat Type codes.

Location		Abundance					Characteristics	
ID loc.	Roost site name	Mean count	Rank	Range	% use	no. obs	Habitat Type	Km to night roost
LA 1	Long Beach Hrb. E. breakwater	234.9	1*	53 -690	100	19	BRW	0
LA 2	Long Beach Hrb. Mid brw	235.8	1*	31 -650	100	19	BRW	0
LA 3	San Pedro jetty	31.4	25	0 - 175	94.4	18	JTY	1
LA 3.5	Long Beach Harbor other loc	23.3	28	0 - 69	55.6	9	HRB	2
LA 5	Palos Verdes, White's Point	15.1	34	0 - 91	50.0	12	OSR	8
LA 6.2	Palos Verdes, Portugese Point	12.9	36	0 - 76	54.5	11	OSR	14
LA 6.5	Abalone Cove rocks & shore	11.3	41	0 - 64	41.7	12	OSR	13
LA 8.5	Palos Verdes, Pt. Vicente area	12.0	40	0 - 66	50.0	12	OSR	12
LA 10	Palos Verdes, Lunada Bay	5.3	53	0 - 34	27.3	11	OSR	9
LA 11	King Harbor	65.6	10	0 - 195	76.9	13	JTY	0
LA 12	Marina Del Rey breakwater	323.1	2	31 -640	100	11	BRW	0
LA 12.1	Dockweiler 'breakwater'	6.3	50	0 - 50	30.0	10	BRW	6
LA 15	Malibu area (historic)	14.5	-	0 - 80	45.5	11	MMS	22
LA 16	Malibu Lagoon	40.2	16	0 - 235	66.7	12	EST	24
LA 19	Point Dume and beaches south	12.4	39	0 - 74	23.1	13	OSR	31.5
LA 20	Leo Carillo, Sequit Point	1.0	60	0 - 4	28.5	8	OSR	15.7

* Long Beach breakwaters were counted separately, but function as a single roost.

Table 3d. Diurnal roost site summary on the Southern California mainland coast from fall air surveys 1986-87, 1992-93 and 1998-2000: Ventura County. Rank is the order of the mean count of all roosts. See Table 2 for Habitat Type codes.

Location		Abundance					Characteristics	
ID loc.	Roost site name	Mean count	Rank	Range	% use	no. obs	Habitat Type	Km to night roost
VN 3	Ventura Co. Beaches, south	10.4	42	0 - 44	27.3	11	BCH	10
VN 4	Mugu Lagoon	122.4	4	1 - 313	100	12	EST	0
VN 4.1	Pt. Mugu beaches	6.6	48	0 - 34	25.0	12	BCH	2
VN 4.3	Port Hueneme jetty and beach	1.7	58	0 - 19	16.7	12	JTY	2
VN 5	Channel Islands Harbor	28.9	27	5 - 80	92.3	13	BRW	0
VN 6	McGrath Lake	1.3	59	0 - 7	25.0	12	LAG	4
VN 7	Santa Clara River mouth	35.6	19	0 - 151	84.6	13	RMO	1.5
VN 8	Ventura Harbor breakwater	71.2	7	7 - 237	100	13	BRW	0
VN 9	Ventura River mouth	8.5	43	0 - 84	36.4	11	RMO	4.5
VN 10	Mobil Oil Pier (historic)	179.1	-	0 - 739	72.7	11	MMS	19
VN 11	Rincon Island oil platform	97.1	6	0 - 429	83.3	12	MMS	19.5

Table 3e. Diurnal roost site summary on the Southern California mainland coast from fall air surveys 1986-87, 1992-93 and 1998-2000: Santa Barbara County. Rank is the order of the mean count of all roosts. See Table 2 for Habitat Type codes.

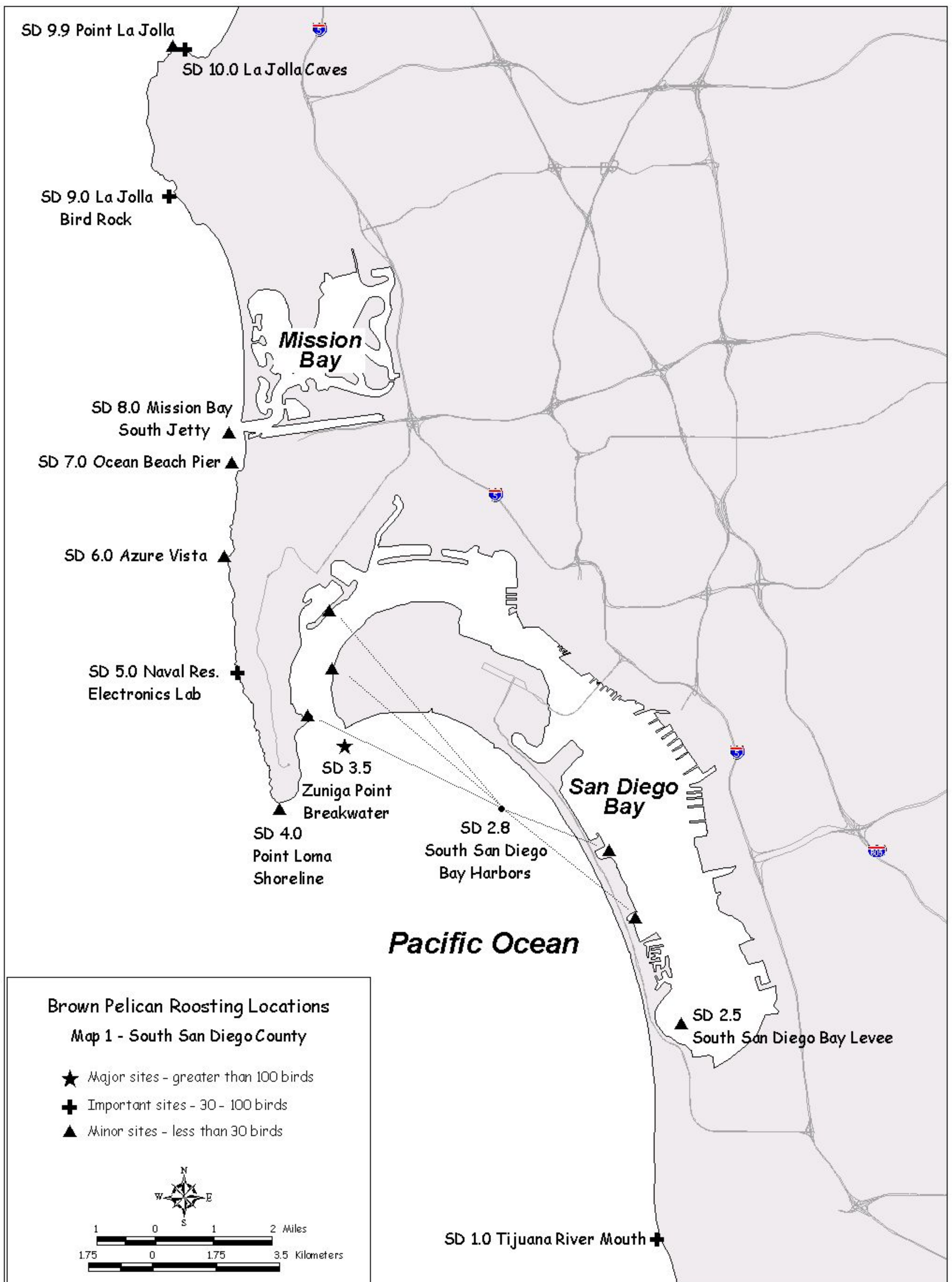
Location		Abundance					Characteristics		
ID loc.	Roost site name	Mean count	Rank	Range	% use	no. obs	Habitat Type	Km to night roost	
SB 1.5	South Santa Barbara beaches	7.6	45	0 - 28	60.0	12	BCH	10	
SB 3	Santa Barbara Harbor outer (historic)	180.8	-	0 -1480	76.9	13	MMS	41*	
SB 4	Santa Barbara Harbor, inner	32.0	24	0 - 93	84.6	13	HRB	42*	
SB 5	Sandpiper Pier, Coal Oil Pt.	53.4	12	12 -160	100	13	MMS	0	
SB 6	Bell Canyon beach area	16.4	33	0 - 76	61.5	13	BCH	3	
SB 7	Santa Barbara County beaches: Naples - El Capitan	22.5	29	0 - 60	53.8	13	BCH	54*	
SB 8	Santa Barbara County beaches El Capitan to Gaviota	34.9	20	5 - 107	100	12	BCH	55 *	
SB 9	Santa Barbara County beaches Gaviota to Pt. Conception	63.0	8	0 - 481	90.9	9	BCH	51 *	
SB 10	Government Point	57.3	11	0 - 248	62.7	10	CRS	49*	

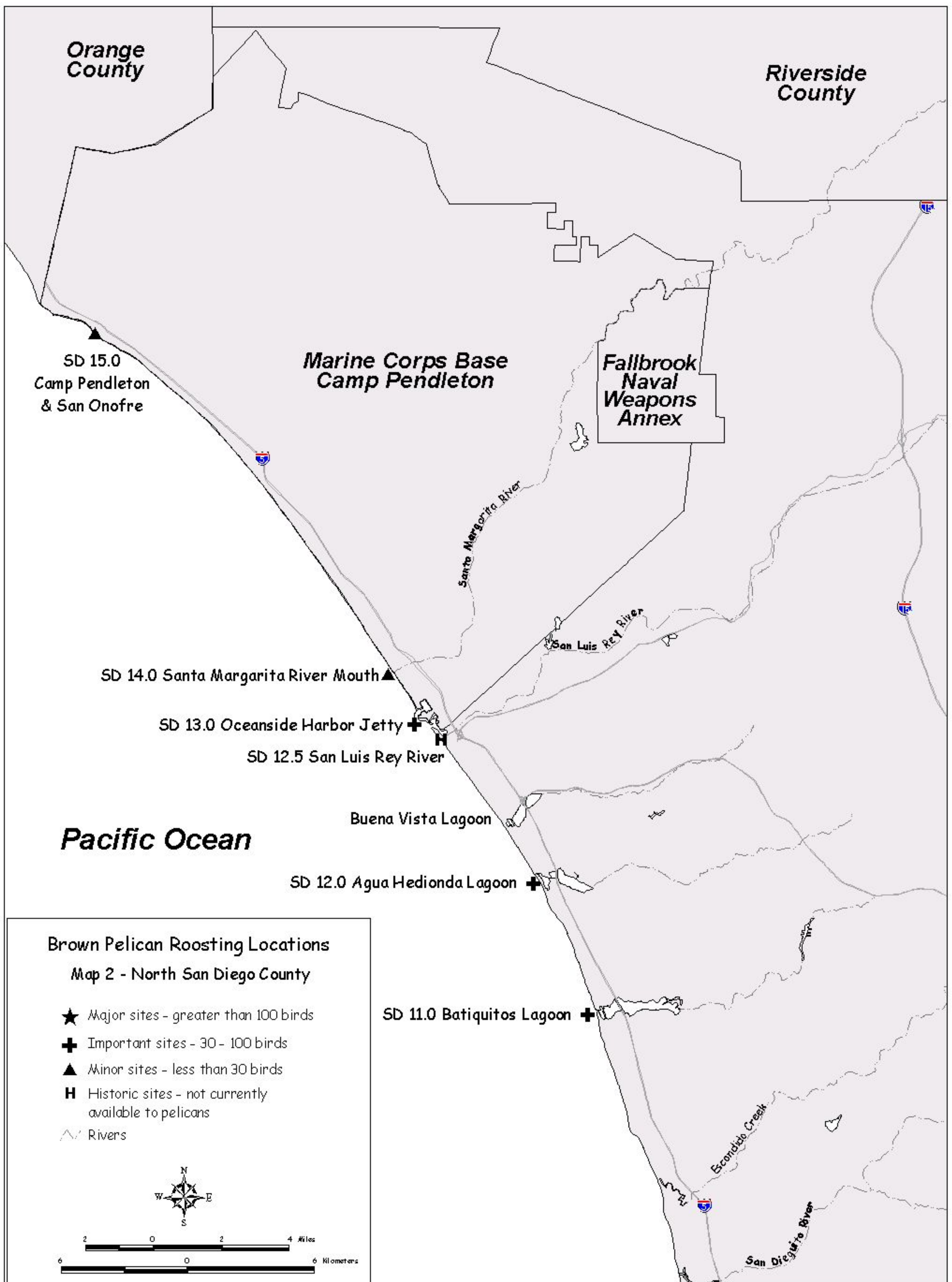
* distance to Channel Islands roosts

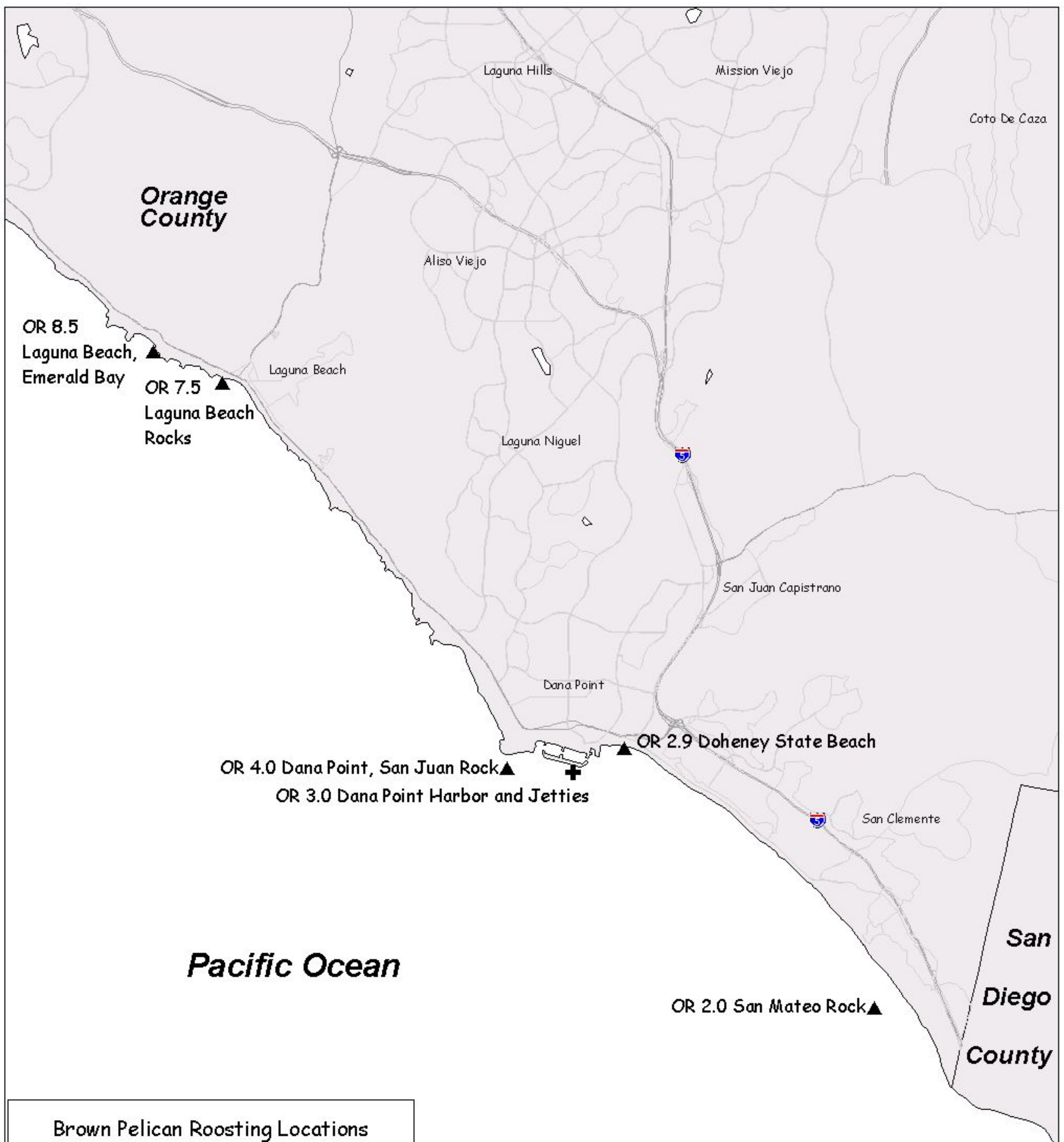
Table 4. Total number of Brown Pelicans at mainland roosts in three regions of California during fall surveys in 1998, 1999, and 2000. Southern California 2000 data area provided by USGS/Humboldt State University. Northern California includes from Oregon to Point Reyes, Central California from Drake's Bay to Point Conception, and southern from Government Point to Mexico.

Region	1998	1999	2000	3 year mean
Northern	4,770 (17.0%)	4,918 (20.1%)	5,300 (14.4%)	4,996 (16.8%)
Central	20,262 (72.0%)	16,939 (69.3%)	27,728 (75.5%)	21,643 (72.7%)
Southern	3,092 (11.0%)	2,604 (10.6%)	3,711 (10.1%)	3,136 (10.5%)
Statewide	28,124	24,461	36,739	29,775

Appendix A. Maps of Brown Pelican roost sites in southern California.



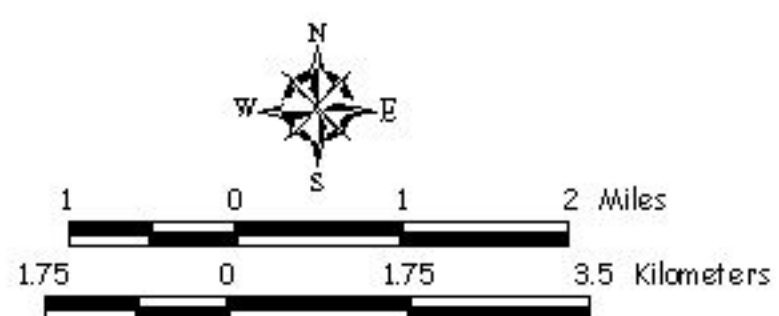


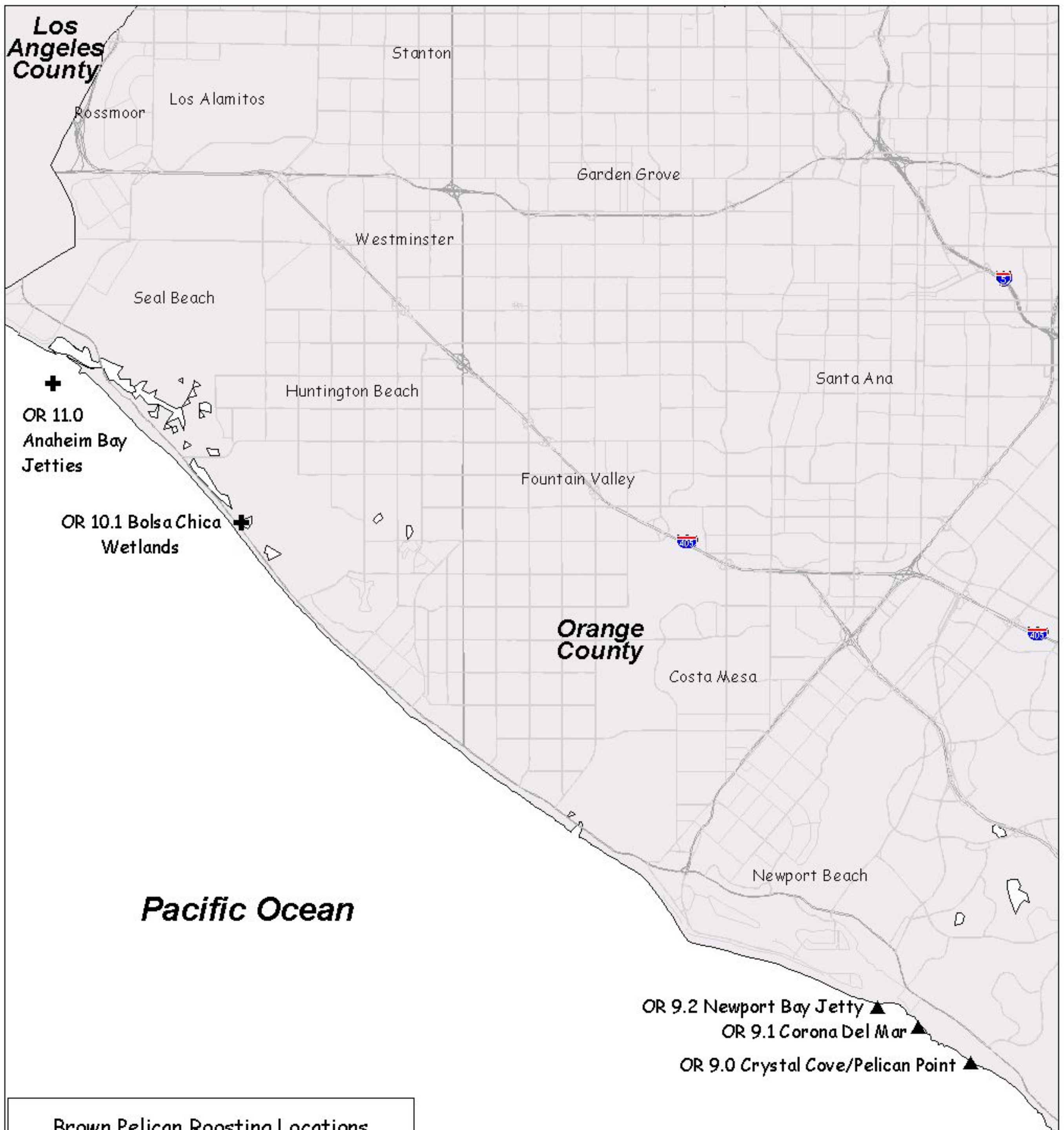


Brown Pelican Roosting Locations

Map 3 - South Orange County

- ★ Major sites - greater than 100 birds
- ⊕ Important sites - 30 - 100 birds
- ▲ Minor sites - less than 30 birds

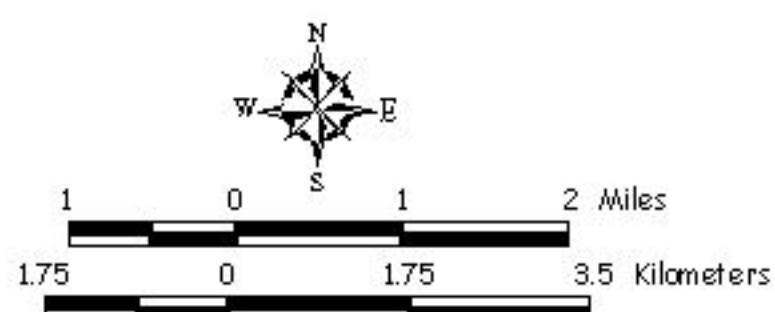


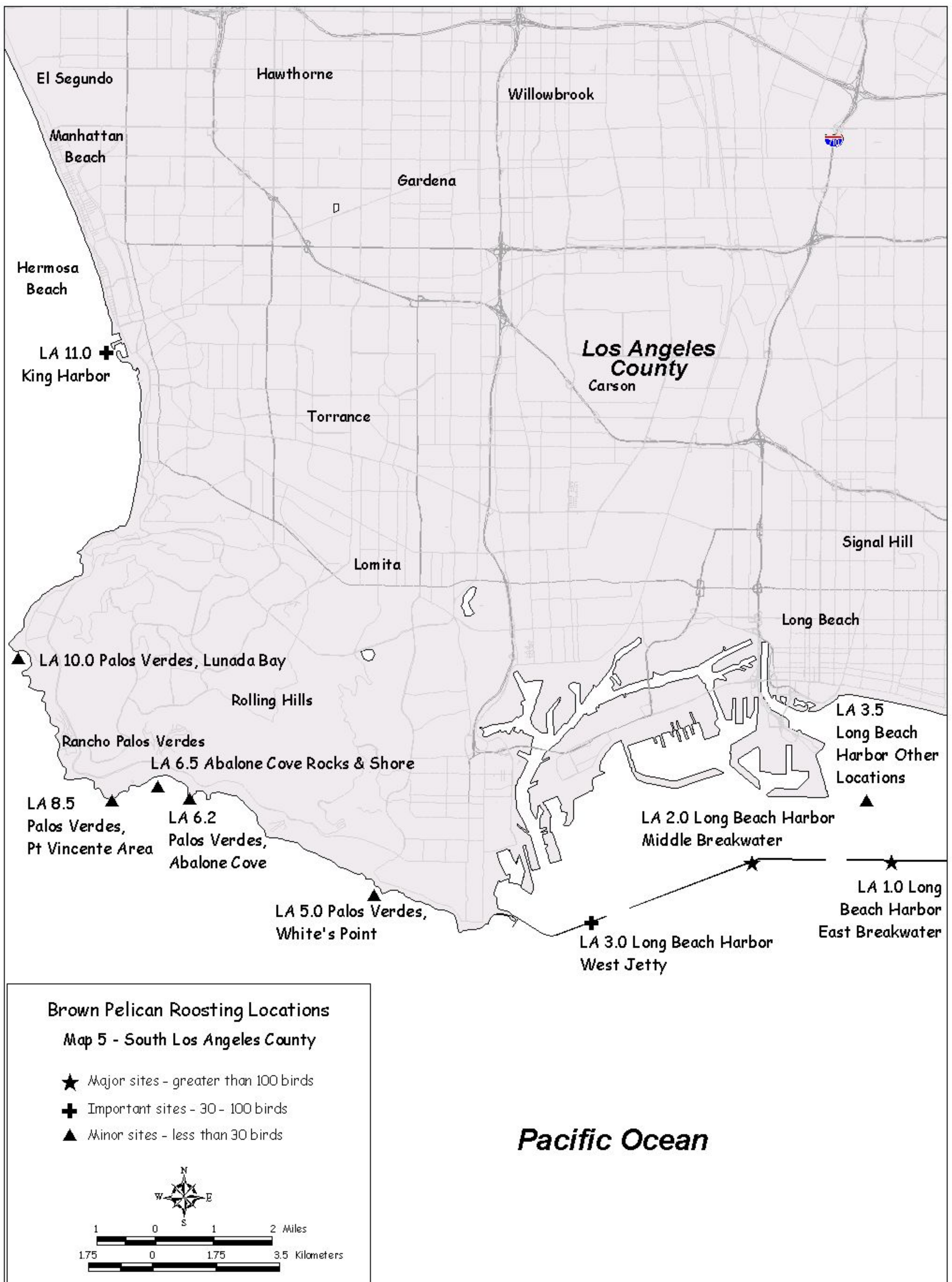


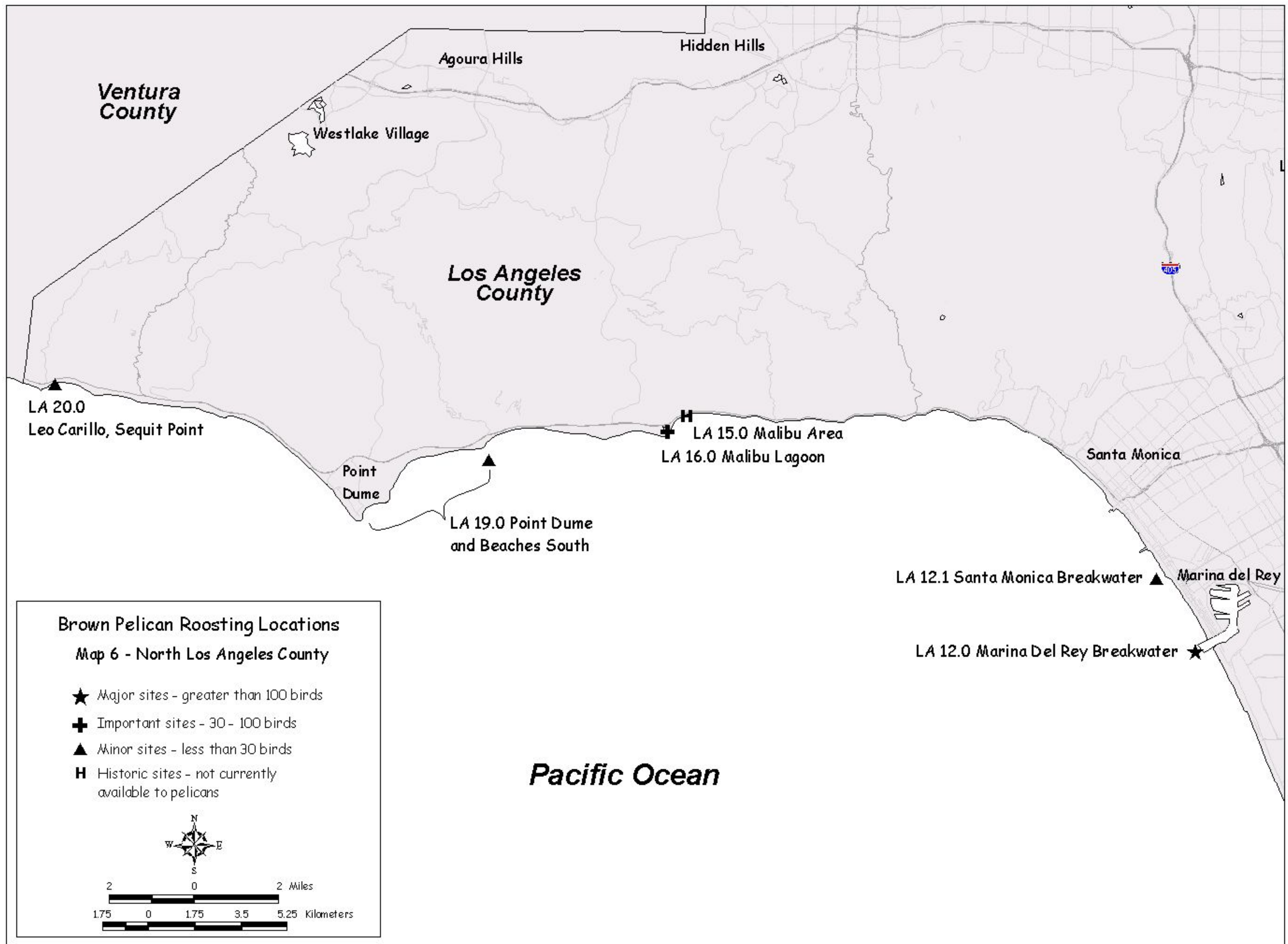
Brown Pelican Roosting Locations

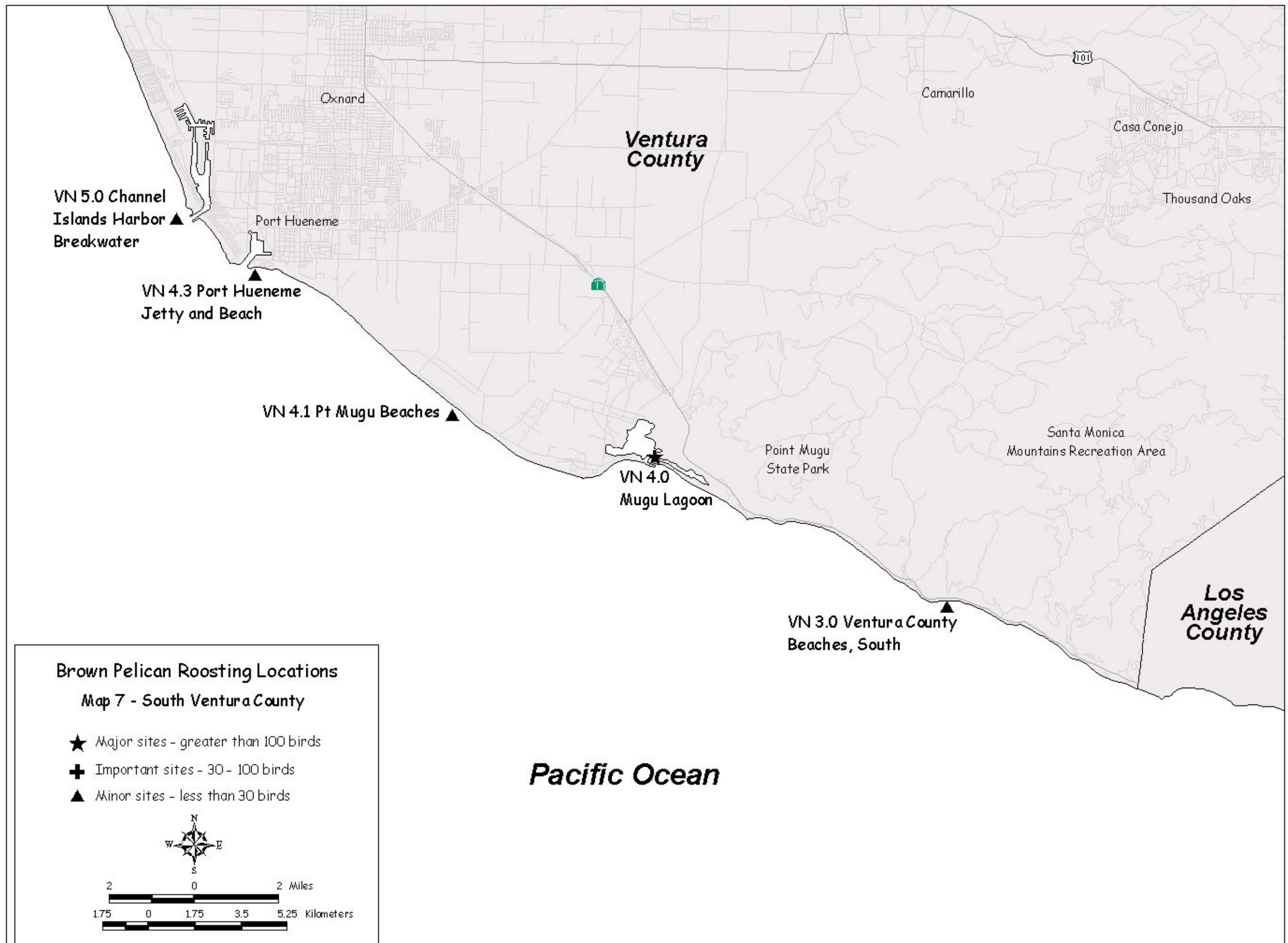
Map 4 - North Orange County

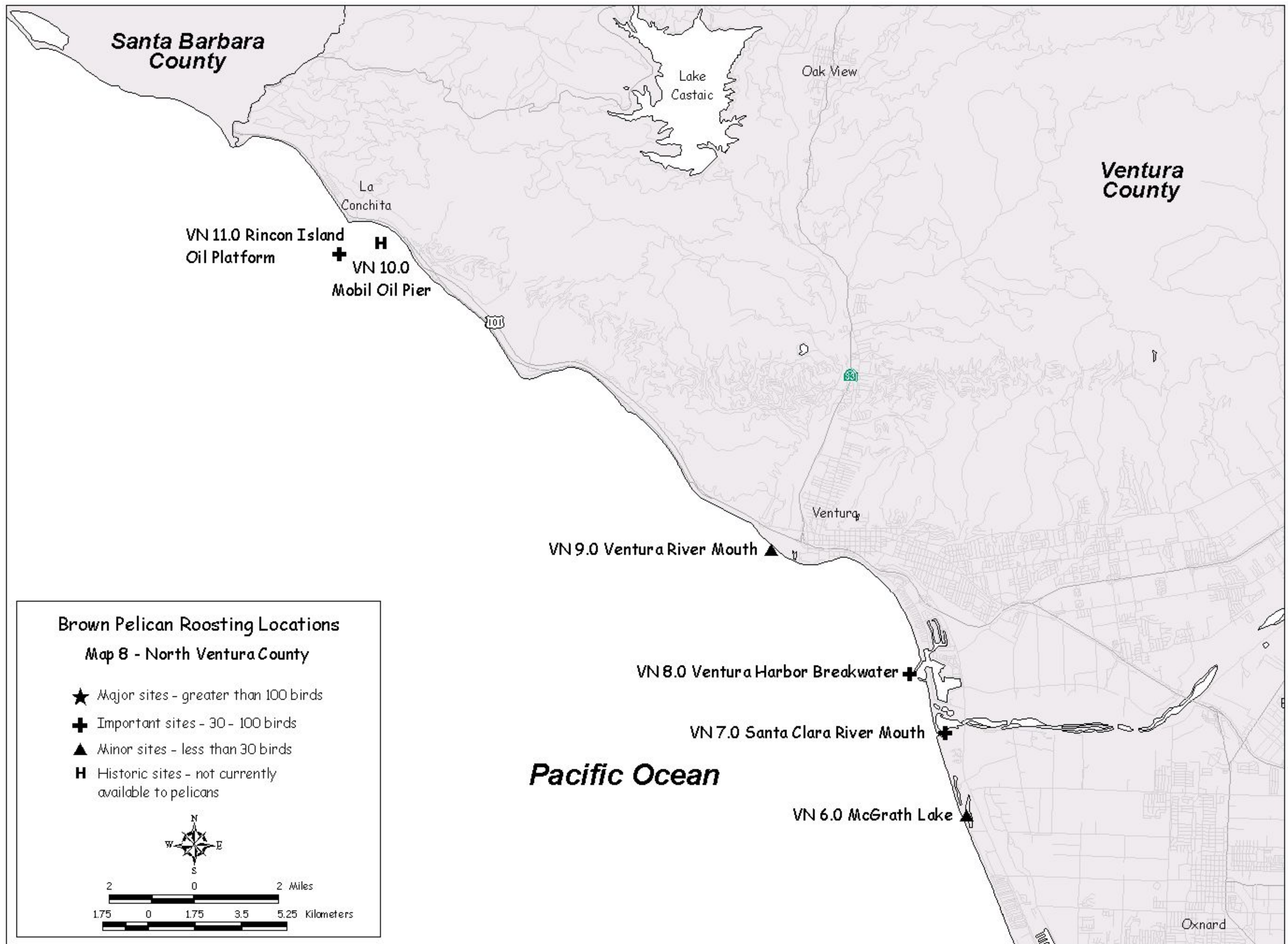
- ★ Major sites - greater than 100 birds
- ✚ Important sites - 30 - 100 birds
- ▲ Minor sites - less than 30 birds

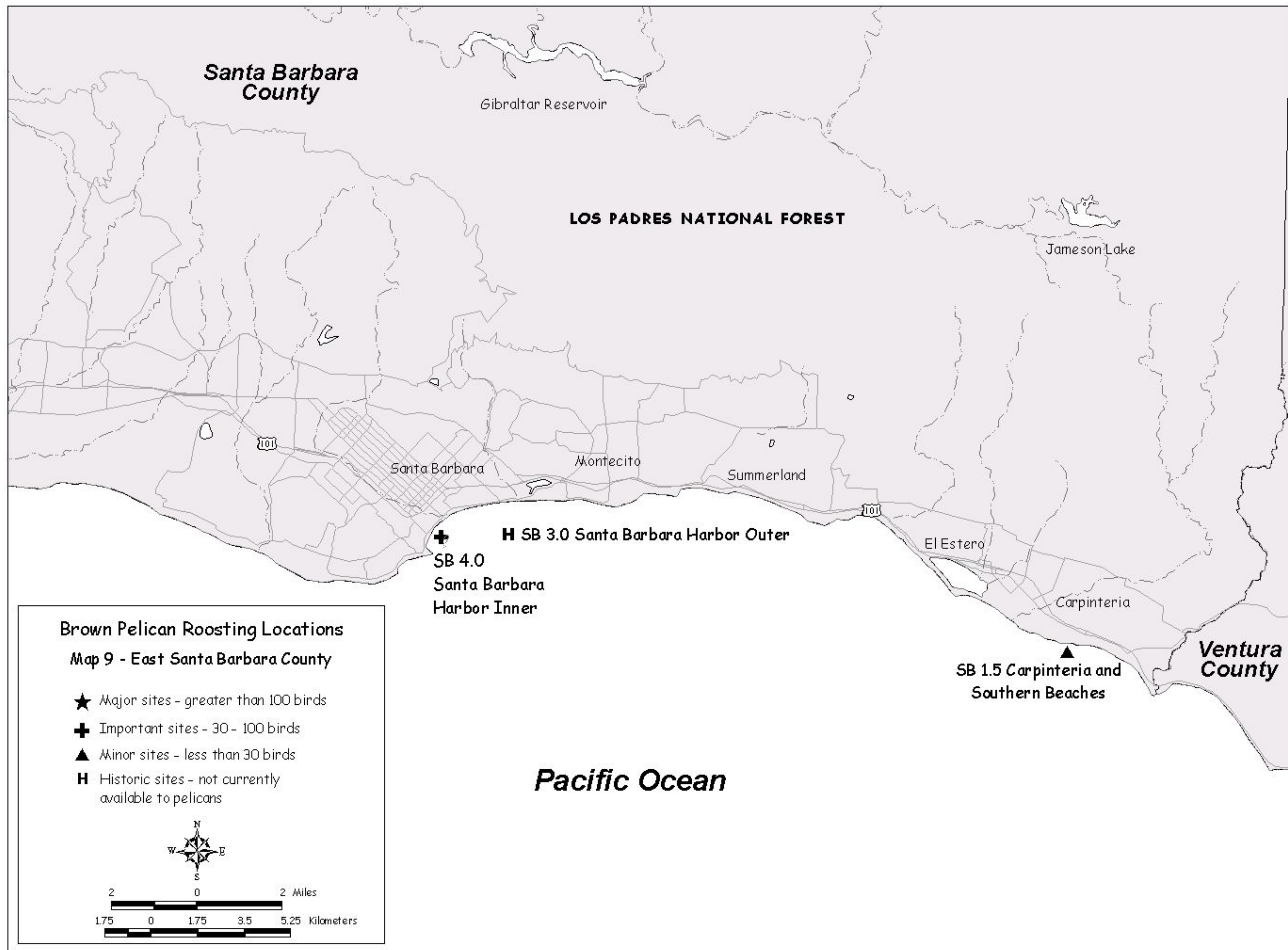


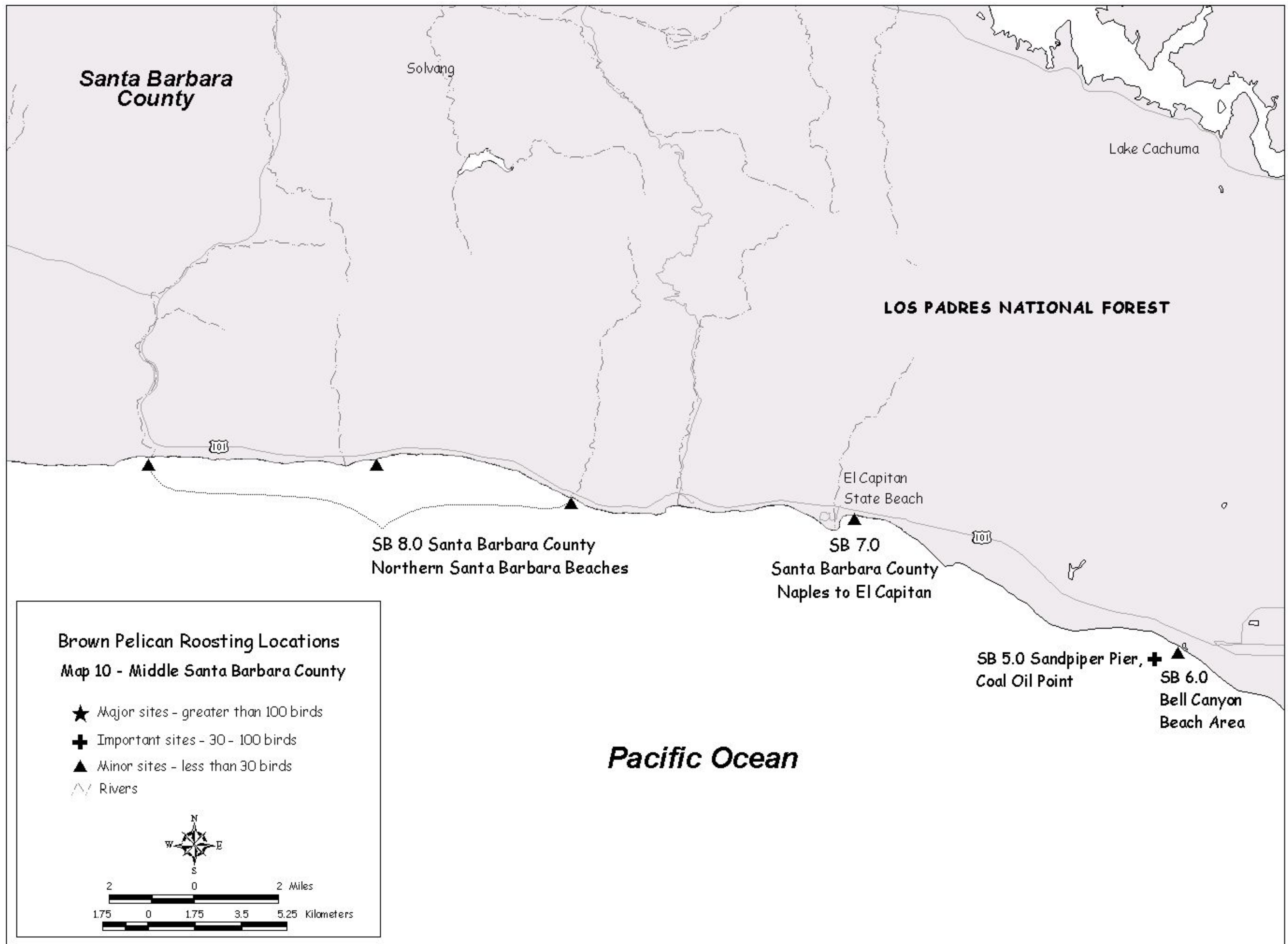


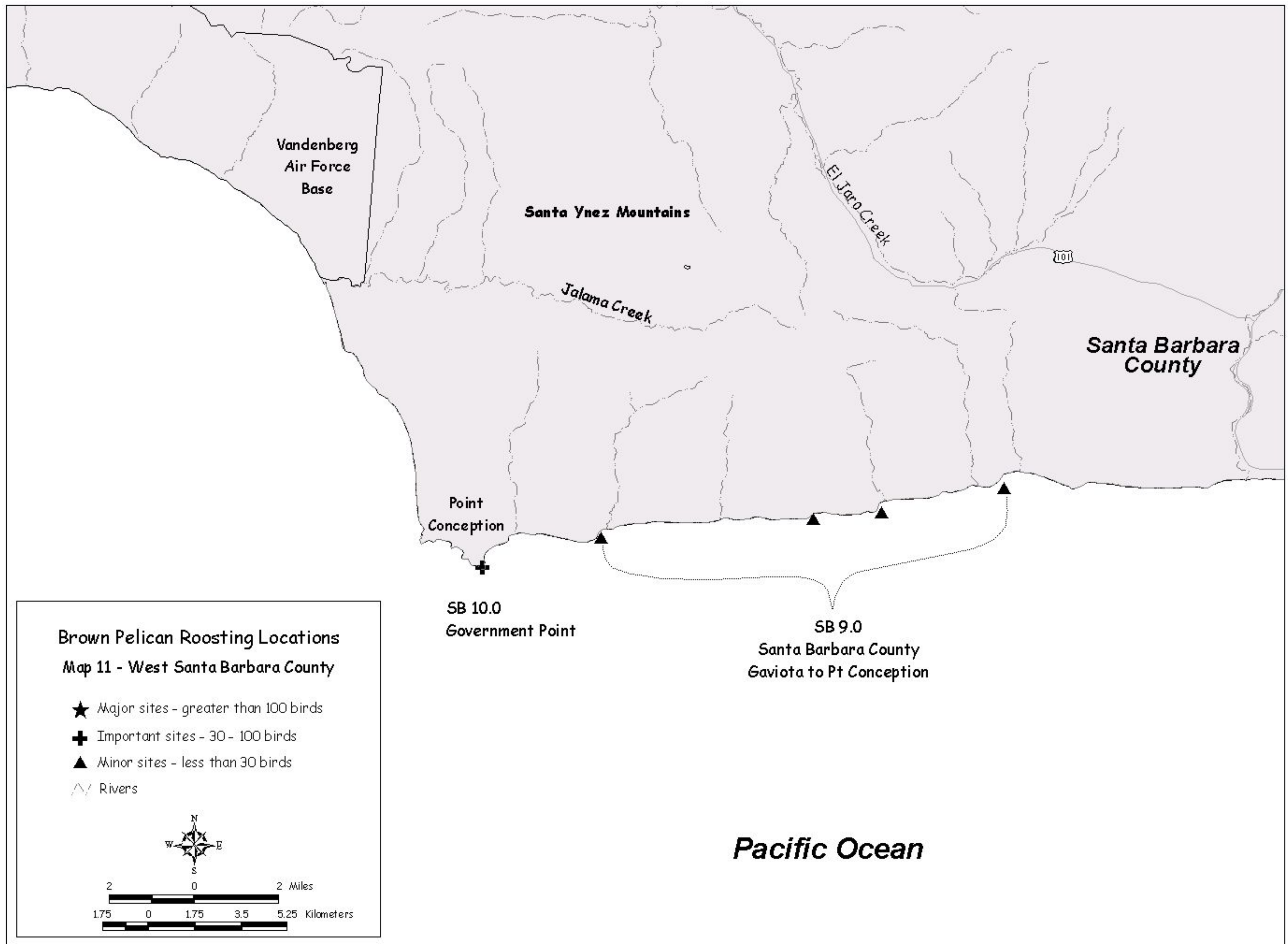












Appendix B. Aerial survey counts of Brown Pelicans at roost sites in southern California

County codes: SD= San Diego, OR= Orange, LA= Los Angeles, VN= Ventura, and SB= Santa Barbara.

Manage are categories of agencies with primary management jurisdiction.

Habitat categories are described in the text, Table 2.

Total BRPE is the total roost count.

Month	Day	Year	Co	Rst. No.	Location	Own	Manage	Habitat	Total BRPE	NOTE
9	25	1998	SD	1.0	TIJUANA RIVER	PUBL	FWS NWR	RMO	25	
8	25	1999	SD	1.0	TIJUANA RIVER	PUBL	FWS NWR	RMO	34	
9	25	1998	SD	2.5	SOUTH SAN DIEGO BAY	PRIV	FWS NWR	LEV	26	
8	25	1999	SD	2.5	SOUTH SAN DIEGO BAY	PRIV	FWS NWR	LEV	0	
9	25	1998	SD	2.8	SAN DIEGO BAY	PRIV	PRIV/MILL	HRB	1	INCOMPLETE COV.
8	25	1999	SD	2.8	SAN DIEGO BAY	PRIV	PRIV/MILL	HRB	96	
9	25	1998	SD	3.5	ZUNIGA POINT	PUBL	ARMY CORPS	BRW	377	
8	25	1999	SD	3.5	ZUNIGA POINT	PUBL	ARMY CORPS	BRW	221	
9	25	1998	SD	4.0	POINT LOMA	PUBL	BLM	CRS	24	
8	25	1999	SD	4.0	POINT LOMA	PUBL	BLM	CRS	0	
9	25	1998	SD	5.0	NAVY ELECTRONICS LAB	MILL	USNAVY	CRS	0	
8	25	1999	SD	5.0	NAVY ELECTRONICS LAB	MILL	USNAVY	CRS	0	
9	25	1998	SD	6.0	AZURE VISTA ROCKS	PUBL	BLM	OSR	0	
8	25	1999	SD	6.0	AZURE VISTA ROCKS	PUBL	BLM	OSR	0	
9	25	1998	SD	7.0	OCEAN BEACH PIER	PRIV	PRIV	MMS	3	
8	25	1999	SD	7.0	OCEAN BEACH PIER	PRIV	PRIV	MMS	0	
9	25	1998	SD	8.0	MISSION BAY S. JETTY	PUBL	ARMY CORPS	JTY	0	
8	25	1999	SD	8.0	MISSION BAY S. JETTY	PUBL	ARMY CORPS	JTY	0	
9	25	1998	SD	9.0	BIRD ROCK, LA JOLLA	PUBL	BLM	OSR	4	
8	25	1999	SD	9.0	BIRD ROCK, LA JOLLA	PUBL	BLM	OSR	0	
9	25	1998	SD	9.9	POINT LA JOLLA	PUBL	LA JOLLA	CRS	0	
8	25	1999	SD	9.9	POINT LA JOLLA	PUBL	LA JOLLA	CRS	75	
9	25	1998	SD	10.0	LA JOLLA CAVES	PUBL	LA JOLLA	CRS	88	
8	25	1999	SD	10.0	LA JOLLA CAVES	PUBL	LA JOLLA	CRS	0	
9	25	1998	SD	10.5	SAN ELIJO LAGOON	PUBL	CDPR	LAG	1	
8	25	1999	SD	10.5	SAN ELIJO LAGOON	PUBL	CDPR	LAG	0	
9	25	1998	SD	11.0	BATIKUITOS LAGOON	PUBL	CDFG	LAG	0	
8	25	1999	SD	11.0	BATIKUITOS LAGOON	PUBL	CDFG	LAG	0	
9	25	1998	SD	12.0	AGUA HEDIONDA LAGOON	PRIV	PRIV/CITY	LAG	30	LAG.COV. INCOMPLETE, +27(23/2)OFFSH
8	25	1999	SD	12.0	AGUA HEDIONDA LAGOON	PRIV	PRIV/CITY	LAG	116	
9	25	1998	SD	13.0	OCEANSIDE HARBOR	PUBL	ARMY CORPS	JTY	75	
8	25	1999	SD	13.0	OCEANSIDE HARBOR	PUBL	ARMY CORPS	JTY	0	
9	25	1998	SD	14.0	SANTA MARGARITA RIVER	MILL	US ARMY	RMO	99	
8	25	1999	SD	14.0	SANTA MARGARITA RIVER	MILL	US ARMY	RMO	0	
9	25	1998	SD	14.1	CAMP PENDELTON	MILL	US MARINES	BCH	0	
8	25	1999	SD	14.1	CAMP PENDELTON	MILL	US MARINES	BCH	0	
9	25	1998	SD	15.0	SAN ONOFRE SB	PUBL	CDPR	BCH	0	
8	25	1999	SD	15.0	SAN ONOFRE SB	PUBL	CDPR	BCH	0	
9	25	1998	OR	2.0	SAN MATEO ROCK	PUBL	BLM	OSR	0	
8	25	1999	OR	2.0	SAN MATEO ROCK	PUBL	BLM	OSR	0	
9	25	1998	OR	2.9	DOHENY STATE BEACH	PUBL	CDPR	RMO	4	
8	25	1999	OR	2.9	DOHENY STATE BEACH	PUBL	CDPR	RMO	0	
9	25	1998	OR	3.0	DANA POINT HARBOR	PUBL	ARMY CORPS	JTY	133	
8	25	1999	OR	3.0	DANA POINT HARBOR	PUBL	ARMY CORPS	JTY	124	
9	25	1998	OR	4.0	SAN JUAN ROCKS	PUBL	BLM	OSR	3	
8	25	1999	OR	4.0	SAN JUAN ROCKS	PUBL	BLM	OSR	0	
9	25	1998	OR	5.0	MUSSEL COVE	PUBL	BLM	OSR	0	
8	25	1999	OR	5.0	MUSSEL COVE	PUBL	BLM	OSR	0	
9	25	1998	OR	6.0	ALISO POINT ROCKS	PUBL	BLM	OSR	0	
8	25	1999	OR	6.0	ALISO POINT ROCKS	PUBL	BLM	OSR	0	
9	25	1998	OR	7.5	LAGUNA BEACH ROCKS	PUBL	BLM	OSR	133	INCL. ALL LAGUNA BCH AREA
8	25	1999	OR	7.5	LAGUNA BEACH ROCKS	PUBL	BLM	OSR	8	
9	25	1998	OR	8.5	EMERALD BAY ROCKS	PUBL	BLM	OSR	0	
8	25	1999	OR	8.5	EMERALD BAY ROCKS	PUBL	BLM	OSR	0	
9	25	1998	OR	9.0	PELICAN POINT	PUBL	BLM	OSR	0	
8	25	1999	OR	9.0	PELICAN POINT	PUBL	BLM	OSR	0	
9	25	1998	OR	9.1	ARCH ROCK	PUBL	BLM	OSR	0	
8	25	1999	OR	9.1	ARCH ROCK	PUBL	BLM	OSR	0	
9	25	1998	OR	9.2	NEWPORT BAY JETTY	PUBL	ARMY CORPS	JTY	0	
8	25	1999	OR	9.2	NEWPORT BAY JETTY	PUBL	ARMY CORPS	JTY	0	
9	25	1998	OR	10.1	BOLSA CHICA WETLANDS	PUBL	CDFG/B.C.	LAG	69	
8	25	1999	OR	10.1	BOLSA CHICA WETLANDS	PUBL	CDFG/B.C.	LAG	0	
9	25	1998	OR	11.0	ANAHEIM BAY S JETTY	PUBL	ARMY CORPS	JTY	224	
8	25	1999	OR	11.0	ANAHEIM BAY S JETTY	PUBL	ARMY CORPS	JTY	7	
9	25	1998	LA	1.0	LONG BEACH HRB EAST BRW	PUBL	ARMY CORPS	BRW	293	
8	25	1999	LA	1.0	LONG BEACH HRB EAST BRW	PUBL	ARMY CORPS	BRW	72	
9	25	1998	LA	2.0	LONG BEACH HRB MID BRW	PUBL	ARMY CORPS	BRW	244	
8	25	1999	LA	2.0	LONG BEACH HRB MID BRW	PUBL	ARMY CORPS	BRW	31	

Month	Day	Year	Co	Rst. No.	Location	Own	Manage	Habitat	Total BRPE	NOTE
9	25	1998	LA	3.0	SAN PEDRO JETTY	PUBL	ARMY CORPS	JTY	17	
8	25	1999	LA	3.0	SAN PEDRO JETTY	PUBL	ARMY CORPS	JTY	9	
9	25	1998	LA	3.5	LONG BEACH HARBOR OTHER	UK		HRB	70	31 ON LEVEE, 38 ON INDUST. BARGE
8	25	1999	LA	3.5	LONG BEACH HARBOR OTHER	UK		HRB	5	
9	25	1998	LA	5.0	WHITE'S POINT	PUBL	BLM	OSR	6	
8	26	1999	LA	5.0	WHITE'S POINT	PUBL	BLM	OSR		NO SURVEY
9	25	1998	LA	6.2	PORTUGUESE POINT	PUBL	BLM	OSR	1	
8	26	1999	LA	6.2	PORTUGUESE POINT	PUBL	BLM	OSR		NO SURVEY
9	25	1998	LA	6.5	ABALONE COVE ROCKS	PUBL	BLM	OSR	13	
9	25	1998	LA	8.5	LONG POINT	PUBL	BLM	OSR	0	
9	25	1998	LA	10.0	LUNADA BAY ROCKS	PUBL	BLM	OSR	0	
9	25	1998	LA	11.0	KING HARBOR	PUBL	ARMY CORPS	JTY	48	
8	26	1999	LA	11.0	KING HARBOR	PUBL	ARMY CORPS	JTY	35	9/11/99 GROUND DATA
9	25	1998	LA	12.0	MARINA DEL REY	PUBL	ARMY CORPS	BRW		NO SURVEY, CONT. @ TOPANGA CYN
9	11	1999	LA	12.0	MARINA DEL REY	PUBL	ARMY CORPS	BRW	299	9/11/99 GROUND DATA
9	25	1998	LA	12.1	DOCKWEILER REEF	PUBL	ARMY CORPS	BRW	0	
8	26	1999	LA	12.1	DOCKWEILER REEF	PUBL	ARMY CORPS	BRW	0	
9	25	1998	LA	14.0	LAS FLORES ROCK	PUBL	BLM	OSR	0	
8	26	1999	LA	14.0	LAS FLORES ROCK	PUBL	BLM	OSR	0	
9	25	1998	LA	16.0	MALIBU LAGOON	PUBL	CDPR	EST	97	
8	26	1999	LA	16.0	MALIBU LAGOON	PUBL	CDPR	EST	78	
9	25	1998	LA	19.0	POINT DUME	PUBL	BLM/CDPR	CRS	0	
8	26	1999	LA	19.0	CORRAL BEACH	PUBL	BLM/CDPR	OSR	52	
9	25	1998	LA	20.0	LEO CARILLO SB	PUBL	BLM/CDPR	OSR	0	
8	26	1999	LA	20.0	LEO CARILLO SB	PUBL	BLM/CDPR	OSR	0	
9	25	1998	VN	3.0	VENTURA CO. BEACHES S.	PUBL	CDPR	BCH	0	
8	26	1999	VN	3.0	VENTURA CO. BEACHES S.	PUBL	CDPR	BCH	0	
9	25	1998	VN	4.0	MUGU LAGOON	MILL	US NAVY	EST	115	
8	26	1999	VN	4.0	MUGU LAGOON	MILL	US NAVY	EST	56	
9	25	1998	VN	4.1	PT MUGU BEACHES	MILL	US NAVY	BCH	27	
8	26	1999	VN	4.1	PT MUGU BEACHES	MILL	US NAVY	BCH	0	
9	25	1998	VN	4.3	PORT HUENEME	PUBL	ARMY CORPS	JTY	0	
8	26	1999	VN	4.3	PORT HUENEME	PUBL	ARMY CORPS	JTY	0	
9	25	1998	VN	5.0	CHANNEL ISLANDS HARBOR	PUBL	ARMY CORPS	BRW	7	
8	26	1999	VN	5.0	CHANNEL ISLANDS HARBOR	PUBL	ARMY CORPS	BRW	46	
9	25	1998	VN	6.0	MCGRATH LAKE	PUBL	CDPR	LAG	0	
8	26	1999	VN	6.0	MCGRATH LAKE	PUBL	CDPR	LAG	0	
9	25	1998	VN	7.0	SANTA CLARA RIVER	PUBL	CDPR	RMO	43	
8	26	1999	VN	7.0	SANTA CLARA RIVER	PUBL	CDPR	RMO	151	
9	25	1998	VN	8.0	VENTURA HARBOR	PUBL	ARMY CORPS	BRW	59	WEAK PHOTO COVERAGE
8	26	1999	VN	8.0	VENTURA HARBOR	PUBL	ARMY CORPS	BRW	237	
9	25	1998	VN	9.0	VENTURA RIVER	PUBL	CDPR	RMO	5	
8	26	1999	VN	9.0	VENTURA RIVER	PUBL	CDPR	RMO	0	
9	25	1998	VN	11.0	RINCON ISLAND	PRIV	PRIV	MMS	129	
8	26	1999	VN	11.0	RINCON ISLAND	PRIV	PRIV	MMS	429	
9	25	1998	SB	1.5	SOUTH SANTA BARBARA	PUBL	CDPR	BCH	28	11 CARPINTERIA, 17 S STA BARB BCH
9	26	1999	SB	1.5	SOUTH SANTA BARBARA	PUBL	CDPR	BCH	0	
9	25	1998	SB	3.0	SANTA BARBARA OUTER	PRIV	PRIV	MMS	0	
8	26	1999	SB	3.0	SANTA BARBARA OUTER	PRIV	PRIV	MMS	0	
9	25	1998	SB	4.0	SANTA BARBARA INNER	PUBL	STA BARB.	HRB	93	
8	26	1999	SB	4.0	SANTA BARBARA INNER	PUBL	STA BARB.	HRB	64	
9	25	1998	SB	5.0	COAL OIL POINT/SANDPIPER	PRIV	ST. LANDS	MMS	72	
8	26	1999	SB	5.0	COAL OIL POINT/SANDPIPER	PRIV	ST. LANDS	MMS	160	
9	25	1998	SB	6.0	BEACHES	PUBL	CDPR/SB CO	RMO	15	1MI N OF COAL OIL PT.
8	26	1999	SB	6.0	BEACHES	PUBL	CDPR/SB CO	RMO	65	
9	25	1998	SB	7.0	BEACHES	PUBL	CDPR/SB CO	BCH	8	JUST S EL CAPITAN
8	26	1999	SB	7.0	BEACHES	PUBL	CDPR/SB CO	BCH	0	
9	25	1998	SB	8.0	EL CAPITAN BEACHES	PUBL	CDPR/SB CO	BCH	69	
8	26	1999	SB	8.0	EL CAPITAN BEACHES	PUBL	CDPR/SB CO	BCH	71	
9	25	1998	SB	9.0	BEACHES	PRIV	PRIV/HOLLI	BCH	5	
8	26	1999	SB	9.0	BEACHES	PRIV	PRIV/HOLLI	BCH	60	
9	25	1998	SB	10.0	GOVERNMENT POINT	UK		CRS	0	
8	26	1999	SB	10.0	GOVERNMENT POINT	UK		CRS	0	
9	25	1998	SB	11.0	PT CONCEPTION NORTH	MILL	UK	CRS	0	
8	26	1999	SB	11.0	PT CONCEPTION NORTH	MILL	UK	CRS	0	